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Systems Sciences, Inc, Chapel Hill, N C

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SUMMARY OF INFORMATION ON AIR QUALITY NETWORKS AROUND LARGE POINT SOURCES

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This report presents a national summary of air quality monitoring networks operated by large point sources. The focus of the report is on five specific industries: electric utilities, primary copper and lead smelting, pulp and paper mills, oil refineries and sulfuric acid plants; and five monitoring parameters: sulfur dioxide, nitrogen dioxide, particulates, sulfates and meteorology. Summaries are reported on a national and EPA regional basis.

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by

Delbert D. Weers and Mark G. Smith

Systems Sciencer, Inc.
Box 2345
Chapel Hill, N. C. 27514

Contract No. 68-02-1898

EPA Project Officer: Alan Hoffman

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PREFACE

System Sciences, Inc. would like to take this opportunity to express our appreciation to the many individuals and organizations who contributed information used in this report. They are too many to name here, but their kind cooperation allowed this survey to be performed successfully within the necessary time constraints.

EXECUTIVE SUMMARY

This report presents the findings of a survey project, Summary of Information on Air Quality Networks Around Large Point Sources, performed for the Monitoring and Reports Branch by System Sciences, Inc. (SSI).

The purpose of the Survey was to collect and analyze information on extent, magnitude and costs of ambient air quality monitoring performed by industries around large point sources. The focus was on five specific industries (electric utilities, primary copper and lead smelters, pulp and paper mills, oil refineries, sulfuric acid plants) and five monitoring parameters (sulfur dioxide, nitrogen dioxide, particulates, sulfates and meteorology). The major effort involved obtaining nationwide figures on activities by the industries above, through industry associations or direct contacts with individual industries. Contacts with equipment and services vendors produced information on current costs of these items, as did in-depth surveys of industry air quality monitoring in two states. These in-depth surveys also identified as fully as possible industrial monitoring activity in those states, for perspective on the nationwide data.

There were 176 companies identified as monitoring ambient air quality, including 23 miscellaneous industries not noted above. These companies operate 249 monitoring networks around 273 different plants, using a total of 936 monitoring stations. Plants are monitored by networks ranging from single stations to 30 stations, 70% of which fall into the 2-7 station range. Electric utilities dominated the other industries in terms of activity, with 142 networks (57% of the total identified) and 570 stations (60%). Copper and lead smelters and pulp and paper mills also monitor extensively. Oil refineries and sulfuric acid plants operate smaller numbers of monitoring sites, as noted in Table A below. It is noted that the Tennessee Valley Authority and the Army operate networks of 109 and 70 stations respectively.

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Table A: Companies, Networks and Monitoring Stations Identified by Industrial Category

Industrial Category	Companies	Networks	Monitoring Stations
Electric Utilities	64	142	570
Copper/Lead Smelters	7	13	104
Oil Refineries	4	4	11
Sulfuric Acid Plants	1	8	30
Pulp and Paper Mills	30	51	125
Miscellaneous	23	31	96
TOTAL	127	249	936

Comparing industry-operated instrumentation to the State and Local air agency operated instruments reporting to the EPA Storage and Retrieval of Aerometric Data (SAROAD) data base (Table B), several important points can be made. In all areas, the number of industry-operated instruments is substantial in relation to those submitting to SAROAD. The number of industry-operated continuous SO_2 monitors is larger than those submitting even minimal data to SAROAD. In terms of source-oriented continuous SO_2 instruments, the industry total is an order of magnitude greater than minimal SAROAD submissions (770 vs. 51). This suggests an area in which industry-obtained data is highly complementary to EPA's data base, especially for assessment of secondary SO_2 standard compliance. Although details of source- or population-orientation were not available for NO_2 and TSP, it is likely that similar comparisons exist with respect to orientation of instruments.

TABLE B

Industry Instrumentation Findings Compared With SAROAD Stations

	Instrument Types			
	Continuous SO_2	Bubbler SO_2	NO_2	TSP
Industry-Operated, Not Reporting to SAROAD, All Source-Oriented	770	96	67	674
SAROAD Stations with Valid 1974 Data (Source-Oriented Sub-total)	146 (21)	825 (131)	582	2004
SAROAD Stations with Minimal 1974 Data (Source-Oriented Sub-Total)	540 (51)	1563 (202)	---	3788

The first row of Table B shows the numbers of various monitoring instruments which are components of the identified industry networks. Distribution of these totals among industries varies considerably by instrument type according to the purposes and requirements of the industry. Electric utilities dominate all categories as they dominate the Table A totals, except SO_2 bubblers, where pulp and paper mills have more instruments.

Using these estimates of the magnitude of industry-operated monitoring and costs for capital and annual components of monitoring efforts also obtained in this survey, preliminary estimates were made of the national cost of industry ambient air quality monitoring. Planning, construction, and instrumentation and start-up costs for all industry monitoring now in place is estimated to have cost about $50 million over the last 10 years. Annual operation and data-handling costs are estimated in the range of $15 to $25 million per year.

TABLE OF CONTENTS

		Page
	Preface	iii
	Executive Summary	v
	List of Figures and Tables	ix
I.	Introduction	I-1
	Purpose and Scope	I-1
	Survey Methodology	I-2
II.	Overview of Findings	II-1
	Coverage	II-1
	National Summary:	
	Network Level Information	II-3
	Station Level Information	II-5
	Trends Data	II-7
	Geographic Distribution	II-7
	Comparison to Networks Submitting to SAROAD	II-11
III.	Findings by Industry	III-1
	Electric Utilities	III-1
	Copper and Lead Smelters	III-4
	Pulp and Paper Mills	III-6
	Oil Refineries	III-12
	Sulfuric Acid Plants	III-13
	Others	III-15
IV.	State Survey Results	IV-1
	Michigan	IV-1
	Pennsylvania	IV-6
V.	System Operation and Costs	V-1
	Quality Assurance	V-1
	Data Handling	V-3
	Costs	V-5
VI.	National Cost Estimates	VI-1
	Appendix A: State Survey Tallies	A-1
	Appendix B: Survey Materials For Vendor and In-Depth State Surveys	B-1
	Appendix C: Tabulations and Summaries	C-1
	Appendix D: List of Unappended Material Submitted	D-1
	Technical Report Data	E-1

LIST OF TABLES AND FIGURES

TABLES

Number		Page
A	Companies, Networks and Monitoring Stations Identified by Industry	iii
B	Industry Instrumentation Findings Compared With SAROAD Stations	iv
II-1	Tally of Miscellaneous Industries Engaged in Monitoring	II-1
II-2	National Summary: Network-Level Information	II-2
II-3	Network Size Distribution	II-4
II-4	National Summary: Station-Level Information	II-6
II-5	National Summary: Trend Data	II-8
II-6	Regional Summary	II-9
II-7	Region/Source Type Summary	II-10
II-8	Operators of SAROAD Stations	II-12
II-9	Breakdown of Stations with Data in SAROAD File	II-15
III-1	Utility Air Quality Monitoring Networks in the Eastern United States	III-2
III-2	Survey Summary of Copper and Lead Smelter Air Quality Monitoring	III-6
III-3	Survey Summary of Pulp & Paper Mill Air Quality Monitoring	III-7
III-4	Summary of Ambient Air Monitoring Survey	III-9
III-5	Summary of Reasons for Ambient Air Monitoring	III-10
III-6	Reasons for Locating Permanent Ambient Air Monitoring Sites	III-11
III-7	Survey Summary of Oil Refinery Air Quality Monitoring	III-13
III-8	Survey Summary of Sulfuric Acid Plant Air Quality Monitoring	III-14
III-9	Instrumentation at TVA Air Quality Monitoring Stations	III-17
IV-1	Air Quality Monitoring Sites by County	IV-2
IV-2	Survey Summary of State of Michigan Air Quality Monitoring	IV-4

Number		Page
IV-3	Historical Aerometric Data (Instrument-Years) From 1968 Through 1975	IV-7
IV-4	Current Aerometric Data (Instrument-Years Per Year) From 1976 On	IV-8
IV-5	Survey Summary of State of Pennsylvania Air Quality Monitoring	IV-10
V-1	Summary of Cost Estimates	V-7
VI-1	Preliminary National Cost Estimates	VI-2

FIGURES

III-1	Utility Air Quality Monitoring Networks in the Eastern United States	III-2
III-2	TVA Air Quality Monitoring Network	III-18
IV-1	Number of Sensor Sites Per County	IV-3
IV-2	Ambient Air Quality Monitoring in Pennsylvania . .	IV-9

I. INTRODUCTION

Purpose and Scope

The purpose of this survey is to collect and summarize information necessary to estimate, on a national scale, the extent and costs and other pertinent details of ambient air quality monitoring performed by and around large point sources. Estimates of such monitoring activity as of mid-1975 and for projected activity as of the beginning of 1977 are required for trend analysis purposes. Based on importance to air quality and in order to obtain information on a variety of source types, five specific industries were chosen for investigation: electric utilities, primary copper and lead smelters, pulp and paper mills, oil refineries and sulfuric acid plants. Monitored parameters of interest include sulfur dioxide (SO_2), nitrogen dioxide (NO_2), total suspended particulates (TSP), sulfates (SO_4) and meteorology.

This nationwide information, augmented by data on activities and costs obtained through two in-depth state surveys and surveys of monitoring instrument and system vendors, results in the initial summary and analysis of industry-operated monitoring activity presented in Chapters II-VI of this report. The analysis is not only useful to EPA for general information, but also for comparative relevance of industry monitoring to governmental agency monitoring.

Survey findings also present a starting point for investigation of the possible costs and other impacts of EPA regulations felt by industry in the monitoring field. Based on the current characteristics of industry-operated monitoring presented here (reasons for monitoring, magnitude and parameters monitored, quality, handling and availability of data, costs, etc.), EPA can better modify, extend and coordinate policies in this area, which can in turn benefit both industry and EPA.

Survey Methodology

The survey section of the project was divided into three distinct surveys, involving (1) the industries doing the monitoring, (2) vendors of equipment and systems, and (3) in-depth studies of monitoring activity in two states.

Industry Survey--In order to minimize efforts necessary on the part of industry, retain flexibility and assure maximum coverage within project time constraints, the principal method of contact with sources in the nationwide industry survey was by telephone. Initial contacts and research were directed at finding national trade associations related to each industry who might be helpful in obtaining the desired information. In two industries, trade associations had been very active in relation to air quality monitoring, and had data suitable for inclusion in the survey on hand. The National Association of Electrical Companies facilitated use of the recently completed Edison Electrical Institute (EEI) survey on air quality monitoring which is part of EEI's sulfate study program development. The National Council on Air and Stream Improvement supplied the TAPPI (Technical Association of Pulp and Paper Industry) survey data. A number of additional communications were necessary to clarify, revise, and update various aspects of these surveys.

Trade associations and other sources were extremely helpful in compiling lists of major producers and appropriate contacts in the other industries to be surveyed. Telephone conversations were the principal means by which individual industries' activities were determined, but letters were also exchanged in order to clarify matters and to allow surveys to be made within the industries themselves.

During the course of this survey, additional data were offered by interviewed companies on monitoring around plant types not specified in this project, and on other activities. It was also found that the Tennessee Valley Authority (TVA) conducts considerable monitoring around its electric power plants. However, since this information is contained in one large

system which reports to the SAROAD data base, information on TVA has been kept separate from that on other utilities. Another fairly extensive monitoring program organized by the U.S. Army Environmental Hygiene Agency was investigated. Detailed information on these miscellaneous monitoring efforts is contained in Chapter IV under "Others."

Vendor Survey--The basic vendor survey tools were a comprehensive description of a monitoring system, concentrating on basic and add-on station and system components and services, accompanied by a list of estimated prices for the basic and additional components and services as described (see Appendix B). One site visit and a number of telephone discussions were held with a variety of monitoring equipment vendors, during which vendors verified or recommended changes in listed prices or provided their own figures for components, systems or services they handle. Information was obtained from vendors specializing in monitoring instruments, meteorological instruments and data-handling systems, as well as two vendors of complete monitoring systems.

In-Depth State Surveys--Initial contacts were made with personnel in several EPA Regions and several state air pollution control agencies to determine what states would be able to provide a productive in-depth survey within the limitations of this study. The states of Michigan and Pennsylvania were selected because considerable information on industry-operated monitoring systems had already been collected and was available. In Michigan, this had been done by the state air pollution control agency; in Pennsylvania, by a group of industries under the auspices of the Pennsylvania Electric Association. Extensive on-site interviews were held with these parties to obtain as much information as possible on industry-sponsored monitoring in the study states. Supplementary interviews were held with a number of industries with major monitoring programs, concentrating on the purposes of the program, costs, quality assurance, data handling and use, and specific system and instrumentation characteristics.

II. OVERVIEW OF FINDINGS

Coverage

For purposes of obtaining nationwide estimates of monitoring by private industry, it is believed the methods used in this survey are realistic. Coverage of electric utilities, copper and lead smelters, and pulp and paper mills is felt to be excellent. Coverage of monitoring by oil refineries and sulfuric acid plants may have been inadequate for obtaining firm estimates of activity by those industries. Since the first three industries named dominate the latter in numbers of monitoring networks, stations and other statistics as well as in general inclination to monitor (see Table II-2 and discussions in Chapter III), the effect of instances of questionable coverage of industries on estimation of national totals is probably relatively minor.

In-depth state surveys and data provided by some surveyed companies indicate substantial activity in a variety of industries not specified for survey coverage. These industries, compiled under "Miscellaneous" in this survey, are listed in Table II-1. It may be that industries not included, such as those listed in Table II-1, account for a sufficient amount of miscellaneous monitoring to affect the validity of national estimates of overall private industry monitoring. There is extensive private industry monitoring, but the limits are unknown.

TABLE II-1

TALLY OF MISCELLANEOUS INDUSTRIES
ENGAGED IN MONITORING

Industry Type	Number of Plants Monitoring
Chemical Processing	8
Metals other than Primary Lead/Copper Smelters	7
Auto Plants (possibly metals also)	5
Food Processing, Manufacture	3
Research Facility	2
Oil Shale Tract	1
Rock Quarry	1
Railroad	1
Undetermined	3

TABLE II-2

NATIONAL SUMMARY: NETWORK-LEVEL INFORMATION

Source Type	Companies Monitoring	Networks	Plants Monitored	Monitoring Stations
Electric Utility	64	142	164	570
Copper/Lead Smelter	7+	13	15	104
Oil Refinery	4+	4	4	11
Sulfuric Acid Plant	1	8	8	30
Pulp and Paper Mill*	<30	51	51	125
Subtotal I	<106	218	242	840
Miscellaneous	23+	31	31	96
Subtotal II	<127+	249	273	936
Army (Various)	—	11	11	70
TVA (Power Plants)	—	12	12	109
Total	<127	272	296	1115

+ Totals do not add because several "conglomerate" companies are listed under more than one "source" type industry.

* These figures are based on results of a survey by Technical Association of Pulp and Paper Industries (TAPPI). Exact number of companies was not available.

National Summary: Network-Level Information

Table II-2, "National Summary: Network-Level Information," presents an overview of monitoring activity by industry type, with relevant subtotals, and a grand total for each parameter. The exact number of pulp and paper companies reporting monitoring activity in the Technical Association of Pulp and Paper Industries survey was not provided, but it may be several less than 30 TAPPI respondents. Thus a total of about 125 companies engaged in ambient monitoring have been identified nationwide. Other relevant organizations include the U.S. Army and the Tennessee Valley Authority. The Army activity is principally around ammunition plants and disposal facilities, with some background stations at other sites.

As of July 1976 these companies operated 249 air quality monitoring networks around 273 different plants, using a total of 936 monitoring stations. For the purpose of this survey, one or more stations oriented toward a particular source or group is termed a network and any monitoring site containing a particulate or SO_2 sampler is considered a monitoring station. Activity on the part of the Army and TVA brings the grand total of networks identified to 272, serving 296 plants with 1115 monitoring stations. For the purposes of this report, however, the former set of figures is more relevant, due to the uncertainties of the Army operation and the submission of TVA data to SAROAD.

The networks identified vary considerably in size, as demonstrated by Table II-3. Average network size for utilities was about 4 stations per network. Pulp and paper mill networks averaged between 2 and 3 stations. Over 70% of identified networks were in the 2-7 station range, although several plants had single stations and networks of up to 30 stations were found. In addition to these source-oriented networks, this survey identified two population-oriented networks, totalling 11 stations, run by a copper company, as well as assorted trend or background stations operated by TVA, the Army and one company developing an oil shale tract.

Except for the TVA networks, only one other network, operated by an electric utility, was identified as submitting data to SAROAD.

TABLE II-3

NETWORK SIZE DISTRIBUTION*

	Number of Monitoring Stations						
	1	2-4	5-7	8-10	11-15	16-20	21+
Electric Utilities	16	84	29	7	4	1	1
Copper/Lead Smelters	—	2	4	5	1	1	-
Oil Refineries	1	2	1	-	-	-	-
Sulfuric Acid Plants	1	5	1	1	-	-	-
Miscellaneous	14(1)	12	4	1	-	1	-
Army	2(2)	7(3)	4	3	-	-	-
TVA	3(3)	3	2	2	4	1	-

* Figures above are numbers of networks within the range of the numbers of monitoring stations specified in headings. Network size not available for pulp and paper mills. Parentheses indicate number of trend station networks (non-source, non-population-oriented) included in total.

For three industries, copper and lead smelting, oil refining, and sulfuric acid manufacture, it was found that all companies involved in monitoring actually operate and maintain their own systems. Adequate information on operation of systems was not available for other industries, but considerable contractor activity exists in both systems and services. The Army and TVA systems are self-operated, however.

As to real time access, data are transmitted to a central location from stations in 85% of copper and lead smelter networks, 25% of oil refinery networks, 12% of sulfuric acid plant networks and 4% of pulp and paper mill networks. It is probable that a substantial number of larger electric utility networks have real time access capability, based on those observed in the in-depth state studies and other information.

National Summary: Station-Level Information

Table II-4, "National Summary: Station-Level Information," presents details on the numbers of the most often-used monitoring instruments comprising the stations identified. Excluding the Army and TVA, a total of 770 continuous SO_2 monitors, 96 SO_2 bubblers and 674 particulate samplers were situated in 936 identified stations. The particulate sampler total above includes 641 Hi-Vol samplers and 33 low volume samplers which are operated by a copper company. One noteworthy distinction is the dominance of SO_2 monitors in utility, smelters, refinery and acid plant networks, contrasted with dominance of particulate samplers in pulp and miscellaneous networks.

Not included in Table II-4 are 58 continuous NO_2 monitors and 9 NO_2 bubblers, with 41 and 9, respectively, operated by utilities and the rest by paper mills (5) and miscellaneous sources (12). Sulfate (SO_4) analysis is performed on particulate sampler filters by utilities (48 samplers), copper and lead smelters (49) and miscellaneous industries (10). Heavy metals analysis of 66 particulate sampler filters, for lead, cadmium, zinc, copper and arsenic, is performed by one metals processing company.

TABLE II-4

NATIONAL SUMMARY: STATION-LEVEL INFORMATION

Source Type	Stations	Continuous SO_2 Monitors	Bubbler SO_2 Monitors	Particulate Monitors*	Meteorological Instruments	Meterological Tall Towers
Electric Utility	570	536	29	415	42	45
Copper/Lead Smelter	104	103	0	67	38	5
Oil Refinery	11	10	0	6	4	0
Sulfuric Acid Plant	30	30	0	0	0	0
Pulp and Paper Mill	125	40	60	125	38	2
Subtotal I	840	719	89	613	122	52
Miscellaneous	96	51	7	61	19	2
Subtotal II	936	770	96	674	141	54
Army (Various)	70	70	0	70	70	0
TVA (Power Plants)	109	106	0	55	4	8
Total	1115	946	96	799	215	62

* Includes Hi-Vol and Low-Volume Samplers

Meteorological information for air quality modeling or other evaluation of ambient readings is often gathered for a network by meteorological instruments at a few monitoring sites or by several sets of instruments at different heights on tall towers. In the statistics presented, "meteorological instruments" refers to the former, and "meteorological tall tower" refers to a separate tower, usually over 100 feet tall, complete with its instruments. The Table II-4 total of 141 ordinary meteorological instruments (generally measuring temperature, wind speed, and direction) excludes the Army and TVA, and is likely to be very low due to the lack of information in this area for electric utilities. Information was available, however, on utility tall towers, and the total of 54 tall towers accurately reflects the survey's intended coverage of these sites.

National Summary: Trend Data

Table II-5, "National Summary: Trend Data," presents the basic information acquired in an effort to discern possible trends in installation of monitoring equipment by industries. It is likely that the amount of change in all categories except copper and lead smelters, TVA and miscellaneous does not reflect accurately the trends in these industries due to incomplete coverage of the industry, and (in the case of utilities) inability to obtain trend data from the primary source of survey information. See the final section of Chapter IV for further details on the Army networks, which are currently in development and will most likely number about 50 stations when fully deployed.

Geographic Distribution

Tables II-6 and II-7 provide basic information on the manner in which the monitoring activity identified in this survey is distributed across the country. This distribution reflects many factors, including industrial makeup of the various Regions, attitudes of air pollution enforcement agencies and industry management, extent of monitoring by public agencies and coverage accomplished by this survey.

TABLE II-5

NATIONAL SUMMARY: TREND DATA

Source Type	Stations in Service			Trend Representativeness (see text)	% of Change, 7/75 to 1/77
	July 1975	July 1976	Projected January 1977		
Electric Utility	474	570	576	Fair	+21%
Copper/Lead Smelter	98	104	114	Good	+16%
Oil Refinery	11	11	11	Questionable	——
Sulfuric Acid Plant	30	30	30	Questionable	——
Pulp and Paper Mill	125	125	125	Questionable	——
Subtotal	738	840	856		
Miscellaneous	92	96	96	Fair	+4%
Subtotal	830	936	952		+15%
Army	9	70	61	Questionable	+570%
TVA	190	109	134	Good	+23%
Total	948	1115	1147		21%

TABLE II-6

REGIONAL SUMMARY*

EPA Region	Companies	Networks	Plants	Stations	Continuous SO_2 Monitors	Particulate Monitors	Meteorological Instruments	Meteorological Tall Towers
I	1	1	1	4	4	4	0	0
II	10	15	21	91	88	56	6	7
III	9	26	31	94	92	84	7	10
IV	10	33	37	91	63	76	4	8
V	24	47	53	195	194	136	18	12
VI	10	13	15	65	64	28	14	2
VII	6	10	10	38	38	29	3	3
VIII	6	8	8	44	44	30	17	4
IX	9	12	13	85	84	34	11	4
X	2	2	2	8	8	11	4	0
Subtotal	76+	167	191	715	679	488	84	50
Pulp and Paper National Total	<30	51	51	125	40	125	38	2
Total	<106	218	242	840	719	613	122	52

* Regional totals include utilities, copper and lead smelters, oil refineries and sulfuric acid plants. Miscellaneous source types, TVA and Army programs are not included.

\+ Six multi-region/multi-source type companies affect this total.

TABLE II-7

REGION/SOURCE TYPE SUMMARY*

(Networks: Stations)

EPA Region	Electric Utilities	Copper and Lead Smelters	Oil Refineries	Sulfuric Acid Plants	Miscellaneous
I	1:4	0	0	0	1:3
II	15:91	0	0	0	1:1
III	26:94	0	0	0	3:13
IV	32:88	0	1:3	0	5:29
V	44:188	1:2	1:1	1:4	13:34
VI	6:23	1:18	2:5	4:19	6:9
VII	8:25	2:13	0	0	1:1
VIII	5:16	3:28	0	0	1:5
IX	4:38	5:38	1:5	2:4	0
X	1:3	1:5	0	0	0

* Not included here are TVA, Army and pulp and paper companies. All 109 TVA stations (11 networks) are in Region IV. Regional breakdowns were not available for pulp and paper. Instability in the Army system makes inclusion in this table of marginal value.

Comparison to Networks Submitting to SAROAD

The magnitude and possible significance of industry-operated ambient air quality monitoring efforts can be placed in perspective by comparison to the nationwide monitoring activity from which data are reported to the SAROAD (Storage and Retrieval of Aerometric Data) data bank. Table II-8, "Operators of SAROAD Stations," is a recent tally of the number of stations with SAROAD identification numbers. Also noted, for the private industry breakdown by states, are the number of stations submitting data which met SAROAD criteria for calculation of annual summary statistics, which give some idea of the status of these stations. Due to lack of SAROAD submission information in the source materials for electric utilities and pulp and paper mills, a number of these stations were not identified. Only one private network, a utility operation of 15 stations, was identified as reporting to SAROAD. Some of the rest may be among unsurveyed industries. Another slight discrepancy is noted in this survey's finding that all 112 TVA stations (109 utility and miscellaneous) are submitted to SAROAD, when only 85 were in the data bank. This is probably due to additions to the TVA network and/or the fact that the SAROAD data accessed were only complete through 1974.

Table II-8 also demonstrates the dominance of the SAROAD data bases by monitoring by public agencies. EPA and state and local agencies operate a total of 5807 stations with SAROAD identification numbers, compared to a total of 149 TVA and private industry stations. The figures on nationwide monitoring by industries presented earlier (see Table II-2) indicate that the inventory of stations submitting to the SAROAD data base does not reflect the actual state of industry activity in relation to public agency monitoring. There are probably well over 1000 monitoring stations now being operated by industries (936 identifed in this survey, excluding TVA and Army stations).

There are additional considerations which make this comparison much more meaningful. All the statistics in Table II-2 and Table II-4 represent source-oriented networks around the industries in question, meant to monitor

TABLE II-8

Operators of SAROAD Stations

Operator		Number of Stations
U.S. EPA		655
State Agencies		3313
Local Agencies		1839
Institutions (universities, etc.)		3
Other Federal Agencies		86
TVA	85	
Other (FAA)	1	
Private Industry Total		64

		Valid Data 1974
Alaska	1	
Florida	13	8
Idaho	4	
Illinois	3	
Kentucky	4	
Massachusetts	10	
Minnesota	7	
New York	6	6
Ohio	3	3
Wyoming	13	4

Grand Total 5960

primarily the impact of those sources on surrounding air quality. In addition, many of these networks are in relatively sparsely populated areas. The stations in the SAROAD data base, on the other hand, are heavily population oriented, located in densely populated urban areas to better assess actual exposure of the population to ambient concentrations.

Reliance on gross counts of stations for comparison is also misleading due to the dominance of continuous monitoring of SO_2 in industry monitoring and of bubbler type SO_2 monitors in SAROAD. Bubblers are used to monitor for 24-hour periods, and are used for one day in six day rotations. This produces intermittent records, at best only good for assessing compliance with the 24-hour and annual primary ambient SO_2 standards. Continuous monitors, used by industry because of their concern with episode conditions and relating process control to ambient levels, are capable of providing 3 hour averages for secondary standard assessment and continuous records and all types of averages for other evaluations. Breakdowns of recent SAROAD submissions according to these parameters are provided in Table II-9.

As shown in Table II-9, the number of stations in service increased from 1970 to 1974, but was showing a leveling off trend by 1974. A total of 152 stations (131 bubbler and 21 continuous) identified as source oriented SO_2 stations provided valid data to SAROAD in 1974. Only 21 of 61 continuous source-oriented SO_2 stations provided enough data to be considered valid (75% of readings). These figures can be compared to the total of 770 privately-operated, source-oriented SO_2 monitors identified in this survey (Subtotal II, Table II-4). Assuming comparable data validity, the amount of continuous source-oriented SO_2 data generated by industry networks may be ten times greater than that collected by public agencies. While validity of industry data in terms of SAROAD criteria was not ascertained by the nationwide portion of this survey, observations during the in-depth state survey indicate that at least some industries may well have as high a proportion of valid data under this criteria as public agencies.

Other parameters for which industry monitoring is a significant portion of the national total are particulates and nitrogen dioxide. The total of 674 industry particulate samplers comprises 18% of the minimal SAROAD submissions from 3788 stations in 1974. A total of 68 NO_2 samplers run by industries is 12% of the 1974 SAROAD total of NO_2 samplers with valid annual data (582). Fifty-eight of these industry samplers are continuous, however, compared to a total of about 210 continuous NO_2 samplers in SAROAD in 1974. It is likely that, were data available on source-oriented TSP and NO_2 monitors in SAROAD, the SAROAD/industry comparisons would be similar to those for SO_2.

TABLE II-9

BREAKDOWN OF

STATIONS WITH DATA IN SAROAD FILE[1/]

SULFUR DIOXIDE	1974		1973	1972	1971	1970
Valid Data[2/]	Bubbler	Continuous				
Population-oriented	694	125				
Source-oriented	131	21				
Subtotal	825	146				
Total (bubbler and continuous)	971		716	588	257	184
Minimal Data[3/]						
Population-oriented	1361	479				
Source-oriented	202	61				
Subtotal	1563	540				
Total (bubbler and continuous)	2103		2008	1311	729	403

PARTICULATES	Hi-Vol Samplers				
Valid Data	2004	2024	1889	1032	732
Minimal Data	3788	3762	2975	2044	1283

1/ Extracted from EPA Monitoring and Air Quality Trends Report 1974, EPA-450/1-76-001)

2/ Four valid quarters are required to qualify as a valid annual record.

3/ At least three 24-hour samples or 400 hourly values.

III. FINDINGS BY INDUSTRIAL CATEGORY

This chapter discusses the details of the nationwide survey, industry by industry, touching on the sources used and summarizing relevant details and results.

Electric Utilities

The National Association of Electric Companies and the Edison Electric Institute (EEI) were contacted to determine if the industry had data needed for the survey. Contacts were identified where copies of a recently completed EEI Air Quality Monitoring Survey could be obtained. A copy with maps showing network locations (Fig. III-1) and other information on individual networks was supplied. Additional networks were identified from other contacts made in this survey. For example, the in-depth survey in Michigan identified 13 networks operated by 8 utilities of which only 2 networks operated by 1 utility had appeared on the EEI survey.

Many electric utilities, though not required by Federal regulation, are monitoring the impact of their power plants emissions on the ambient air quality. The Federal Power Commission Form 67 address list shows about 200 companies operating 724 power generation plants, including plants that are nuclear, gas fired, etc. The EEI survey identifies 99 (+ 6 Canadian) ambient air quality monitoring networks operated by 31 (+ 1 Canadian) companies at widely dispersed locations over the nation.* With 43 other identified networks operated by 33 companies not reported by EEI and an estimated 25 networks or more that were not identified, 170 networks is estimated to be the nationwide magnitude of utility-operated networks.

The 142 networks identified around 164 sources leads to the conclusion that about one fourth of the 724 power plants listed with FPC operate their own networks. It is estimated that this includes most of the

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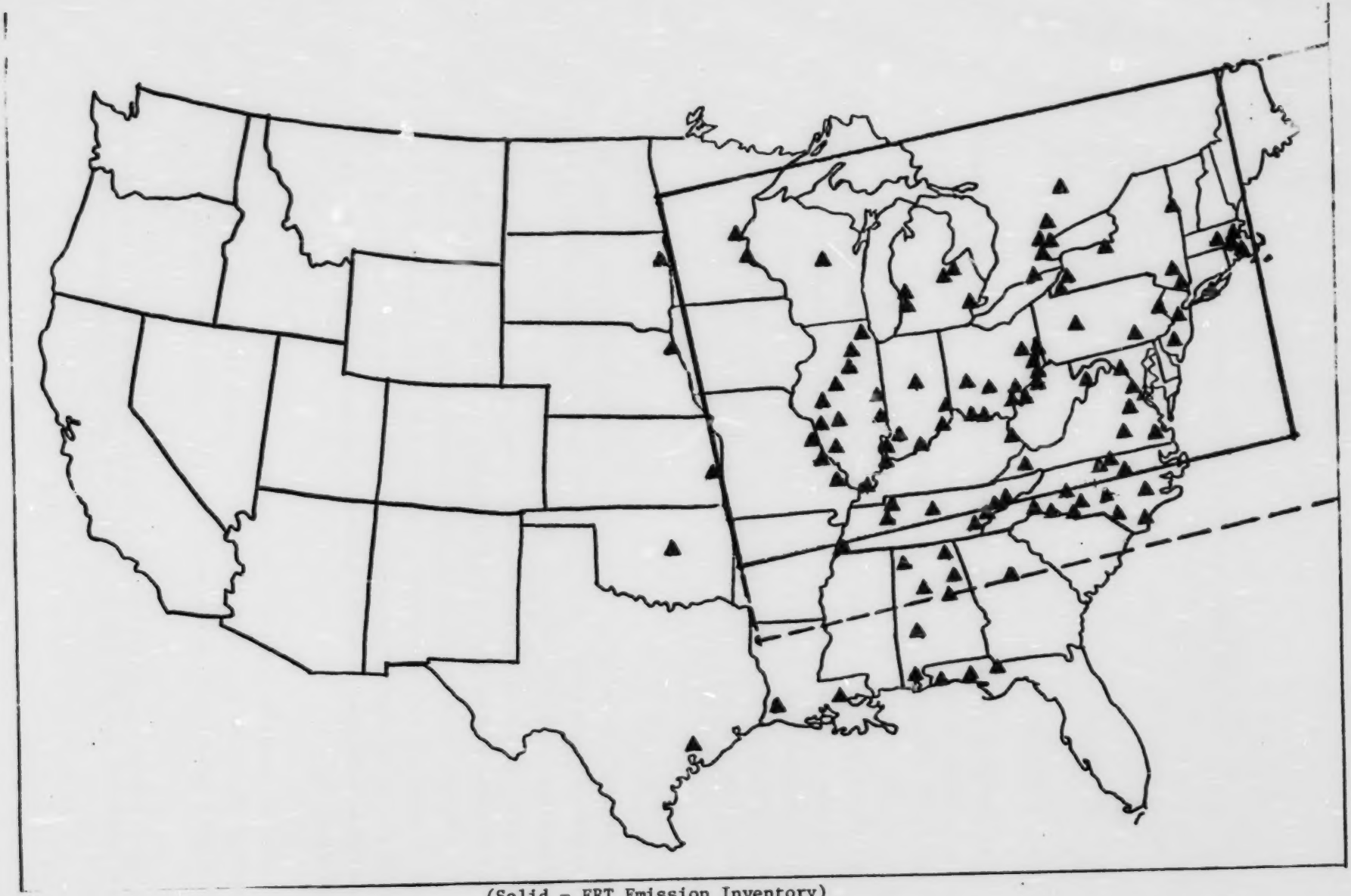
*EEI does not include public power companies, and about 10% of the private power companies, but the EEI Air Quality Monitoring Survey does include TVA.



(Solid - ERT Emission Inventory)
(Dashed - Expanded Grid Area)

Figure III-1 UTILITY AIR QUALITY MONITORING NETWORKS IN THE EASTERN UNITED STATES

large non-urban, utility-operated power plants. This is based on the assumption that most utility power plants are located in urban areas, and many of the 724 plants listed are nuclear, gas-fired, or otherwise are not considered large air pollution sources. The urban plants generally depend on government agency network data to assess impact of plant emissions. An example is Detroit Edison, which depends on Wayne County data for assessment of 8 of their plants.

Table III-1 presents a summary of data on utilities. Figures on NO_2 analyzers, wind speed and direction, other meteorological data, and sulfate analysis are incomplete, because they were not included in the EEI survey, and may underestimate the true national total for utilities by half.

TABLE III-1

SURVEY SUMMARY OF ELECTRIC UTILITY AIR QUALITY MONITORING

		Percent of Total Stations or Networks in this Industrial Category
Number of Networks	142	
Number of Sources	164	
Number of Stations	570	
Number of Stations: SO_2 Continuous Analyzers	536	94%
Number of Stations: SO_2 Bubblers	29	5%
Number of Stations: TSP Samplers	415	73%
Number of Stations: NO_2 Continuous Analyzers	41	7%
Number of Stations: Met. Wind Speed/Direction	42	7%
Number of Stations: Met. Tall Towers	45	8%
Number of Networks Performing Some SO_4 Analysis	10	7%

The EEI survey is part of a utility industry effort to help in determining the impact of sulfates from their plants on the environment. EPRI (The Electric Power Research Institute) is funding the study. Data will be compiled from utilities networks in the area of study. They have chosen the northeast part of the nation (east of the Mississippi, and north of Atlanta) for the study. Several additional stations may be added to those now existing and most of these will be very extensive in parameters covered. A strong comment was voiced by EPRI in response to a report that the state networks probably are more extensive than needed, to the effect that if that were true, EPRI would not have to collect the data their study requires, as it would already be in SAROAD. A second similar comment was voiced by Pennsylvania contacts interviewed. The Pennsylvania data file being created includes utility network data. Much of this will be used in the EEI/EPRI study. Reference is made to the in-depth report of Pennsylvania, Chapter IV, for more detail. A third largely utility-supported study utilizing ambient air quality data is the Florida sulfur oxides study now in progress.

Copper and Lead Smelters

Since trade association data was unavailable, individual companies were identified on the basis of National Emission Data System (NEDS) listings for copper and lead smelter Standard Industrial Classification (SIC) codes. Data were obtained for monitoring around 12 of the 14 copper smelters identified. Coverage of the copper smelting industry is estimated as good. All copper smelters identified had substantial monitoring activity. Differentiation between primary and secondary smelters was a problem, especially for lead. Data could only be obtained for activity around 4 of the 7 possible primary lead smelters identified, one of which performed no monitoring, with a very clean process given as the reason.

Several of the copper and lead smelters identified were combined with other processes, including copper or lead refineries, or zinc fuming. One facility had both a copper smelter and a lead smelter as well as a zinc fuming operation, and had a monitoring network covering the entire complex. There was also one case in which the state had required two

copper smelters to establish a joint monitoring network for Supplemental Control Strategy (SCS) purposes.

A total of 13 networks were found, covering 15 smelters (3 lead, 12 copper). Of these 13 networks, 8 are known to be currently part of SCS operations. Of the rest, one will be part of an SCS system in 1977 and one was originally installed for SCS. One was established for the company's own purposes and the purpose of the last two are unknown. The copper smelting industry has a 40-year history of ambient self-monitoring, for their own reference, including in-house development of continuous SO_2 instruments.

These 13 networks contain a total of 104 monitoring stations, with 2 to 18 stations per network. This includes 103 continuous SO_2 instruments, 67 particulate monitors (28 low-volume, 39 Hi-Vols), 38 wind speed and direction instruments and 5 tall meteorological towers, as shown in Table III-2. A total of 10 more air quality stations and 4 more wind instruments are expected in 1977. Samples from the low-volume particulate instruments of one company's five networks were regularly analyzed for sulfates, lead, cadmium and arsenic (less frequently for zinc, copper). One other company reported occasional heavy metals analysis. Every smelter network identified is self-operated.

In addition, it was determined that one copper producer operates two population-oriented networks in and around two large Arizona cities which are roughly 100 miles from their smelters. With 6 and 5 stations respectively, these networks monitor SO_2, TSP and wind speed and direction at all sites and have at least one site apiece with hydrocarbon, carbon monoxide and ozone monitoring.

TABLE III-2

SURVEY SUMMARY OF COPPER AND LEAD SMELTER AIR QUALITY MONITORING

		Percent of Total Stations or Networks in this Industrial Category
Number of Networks	13	
Number of Sources (smelters only)	15	
Number of Stations	104	
Number of Stations: SO_2 Continuous Analyzers	103	99%
Number of Stations: SO_2 Bubblers	0	0%
Number of Stations: TSP Samplers	67	64%
Number of Stations: Met. Wind Speed/Direction	38	37%
Number of Stations: Met. with Stability	5	5%
Number of Networks Performing Some SO_4 Analysis	5	38%

Pulp & Paper Mills

The National Council for Air and Stream Improvement, an environmental trade association of the pulp and paper industry, was contacted to determine if the pulp and paper industry had data relevant to the survey. They provided a report of results, dated April 26, 1976, of the TAPPI (Technical Association of Pulp and Paper Industry) Ambient Air Monitoring Survey. Additional information was obtained in in-depth studies of states.

The TAPPI survey indicates responses were received from 30 of the 33 major companies. They reported on the monitoring activity at 102 mills. The total mills of the 30 companies is estimated to be 217 mills. Sixty-six of the 102 mills reported some air quality monitoring program, which means about 30% of the 217 mills in the nation have a monitoring program. The survey did not identify the mills or their locations.

Table III-3 summarizes the results of survey information, details of which are presented in Tables III-4 through III-6, taken directly from the TAPPI report. Details on monitoring at several specific pulp and paper mills were obtained during in-depth state surveys. To avoid possible overlaps, however, only TAPPI figures are shown here.

TABLE III-3

SURVEY SUMMARY OF PULP & PAPER MILL AIR QUALITY MONITORING

		Percent of Total Stations or Networks in this Industrial Category
Companies	30	
Number of Networks	51	
Number of Sources	51	
Number of Stations	125	
Number of Stations: SO_2 Continuous Analyzers	40	32%
Number of Stations: SO_2 Bubblers	60	48%
Number of Stations: NO_2 Continuous Analyzers	5	4%
Number of Stations: TSP Samplers	125	100%
Number of Stations: Met. Wind Speed-Direction	38	30%
Number of Stations Met. with Stability	2	2%

Details of the survey indicate a decreasing trend in the number of mills performing monitoring. Particularly large is the decrease in sulfation rate and dust fall monitoring, the major monitoring activity in this industry. The decrease is projected to continue from 1975 to 1976 (see Table III-4). Fifty-three of the mills reported that the networks were self-initiated (see Table III-5 for details). Another 16 report a combination of the above. Only five reported no monitoring as the state agencies were operating a satisfactory network nearby. The reason for site selection is summarized in Table III-6.

The TAPPI report points out that the decline in monitoring is a result of changes in methods and the trend away from traditional monitors (i.e., dust fall, sulfation) by EPA. A further comment was that total total soluble sulfate is an inadequate measure and/or is useless to the paper industry without further breakdown (i.e., sulphuric acid, etc.).

TABLE III-4

SUMMARY OF AMBIENT AIR MONITORING SURVEY[1]

A. Ambient Air Monitoring Programs	1970 thru' 1974		1975		Planned for 1976	
Number of Mills Reporting Programs	56		51		48	
Total Reported Air Sampling Sites	405		283		263	
	Mills	Units[2]	Mills	Units	Mills	Units
B. Meteorological Instrumentation						
Wind Meter						
Direction Only	6	6	2	2	3	3
Direction and Velocity	40	45	37	40	30	33
Ambient Temperature	19	21	16	19	13	15
Ambient Pressure	12	12	10	10	10	10
Ambient Lapse Rate	3	3	2	2	1	1
Rain Gauge	17	17	13	13	11	11
C. Ambient Air Monitoring						
Ambient Suspended Particulate						
Fixed Site Monitoring	37	148	39	127	37	105
Portable Monitoring	8		7		6	
Ambient Dustfall	37	268	16	115	16	127
Ambient Sulfation Rate	20	150	10	87	10	79
Ambient SO_2 Monitors						
Fixed Site Monitoring	24	59	29	77	26	60
Portable Monitoring	7	24	4	18	6	20
Ambient TRS Monitors						
Fixed Site - Continuous Monitoring	6	11	4	7	5	8
Portable - Occasional Monitoring	6	8	4	6	6	8
H_2S	3	7	2	7	2	7
NO_2	2	4	1	5	1	5
Corrosion Index	1	2	1	2	1	2

1. From "TAPPI Ambient Monitoring Survey Report of Results" by Karl C. Ayers.

2. "Units" are monitoring units or instruments.

TABLE III-5

SUMMARY OF REASONS FOR AMBIENT AIR MONITORING[1]

A. Self-Initiated Programs

1. Fifty-three of the 66 mills reporting any type of ambient air program stated that self-initiation played some role in starting their programs.

2. Thirty-seven of these mills reported no reasons other than self-initiation for their programs.

3. Of these 37 mills, 26 still have active ambient air programs.

B. Programs Required by Regulatory Agencies

1. Thirteen of the 66 mills reporting any type of ambient air program stated that their programs were a regulatory requirement.

2. Of these 13 mills, 8 still have active ambient air programs.

3. One of these mills reports that the program it is currently operating is utilizing equipment furnished by the state.

4. Another 16 mills stated that their programs were a combination of self-initiation and regulatory requirement.

5. Of these 16 mills, 14 still have active ambient air programs.

C. Programs Operated by Regulatory Agencies

1. Five additional mills report no program of their own because the state has a convenient ambient air program from which the resulting data is either telemetered to the mill or made available on a routine basis.

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1. From "TAPPI Ambient Monitoring Survey Report of Results" by Karl C. Ayers.

TABLE III-6

REASONS FOR LOCATING PERMANENT AMBIENT AIR MONITORING SITES[1]

26 mills (39% of total)	Site selection based on modeling predictions and/or consideration of prevailing winds and/or recommendations by meteorologist.
19 mills (29% of total)	Sites chosen because mill owns property and/or easy access and/or availability of power.
12 mills (18% of total)	Sites chosen by regulatory agency.
5 mills (8% of total)	Located sites throughout community to determine mill's effect.
4 mills (6% of total)	No reasons given.

1. From "TAPPI Ambient Monitoring Survey Report of Results" by Karl C. Ayers.

Oil Refineries

The oil industry trade association, the American Petroleum Institute (API), had no information on its members' ambient monitoring activity. Major oil refining companies provided the information below.

Two basic conclusions can be drawn from the information obtained. The first is that, compared to the other industries surveyed, air quality monitoring is not felt to be a pressing issue by the oil refining industry. Decisions about and operational responsibility for ambient monitoring generally appear delegated to individual plant managers. In some cases, only the existence of networks or temporary stations or spot checking was determined, with details being unavailable. There were no indications of well-coordinated company-wide monitoring programs such as those found in most other industries.

The second basic conclusion drawn from the contacts made is that the amount of ambient air monitoring conducted by oil refineries is fairly small. A total of five monitoring networks around refineries were identified. Three for which details were available had a total of nine continuous SO_2 instruments, five particulate samplers and four wind speed and direction instruments. One of these networks was actually part of a larger network operated cooperatively by several plants, and one other company also indicated involvement in a cooperative network. At least four companies own fully-equipped mobile trailers, most of which have instrumentation for all criteria pollutants, which are used for spot-checking possible problem areas. While positive details on purposes of these activities were not available, there were indications that several networks may have been installed in response to state regulatory actions.

TABLE III-7

SURVEY SUMMARY OF OIL REFINERY AIR QUALITY MONITORING

Networks	5
Sources	5
*Continuous SO_2 Stations	9
*TSP Samplers	5
*Wind Speed/Direction	4

* For three networks only

Sulfuric Acid Plants

Initial industry contact was made with a general chemical industry trade association, as a more specific organization related to sulfuric acid manufacturing does not exist. The information contained here was obtained from major chemical companies involved in sulfuric acid production. While the coverage of the industry is not felt to be adequate for reliance upon the statistics obtained in a national context, the information obtained is felt to be useful, as it is indicative of the variety of monitoring activity by sulfuric acid producers.

Two producers operate no monitoring programs at all, although one cited monitoring programs carried out by other public and private groups in areas around two of their four plants. A third producer has no continuous ambient monitors with permanent locations, but rather relies on continuous stack monitoring and systematic use of mobile vans for determination and control of the impacts of their six plants on ambient SO_2 levels. This program includes plume-chasing daily or several times daily for six weeks at each plant, with data obtained being used to calibrate an atmospheric dispersion model.

Two other producers operate much larger-scale monitoring efforts. While detailed information on one of these companies could not be obtained under the time constraints of this survey, a general description of their program indicates that it may be fairly similar in

scope to the program of the second producer in this category. This second producer has networks at 8 of 10 sulfuric acid plants, with the only monitored parameter being SO_2. These 8 networks, all operated by the company itself, include 30 sites with continuous SO_2 monitors. They were established principally for the operator's benefit, although one is part of a Supplemental Control Strategy operation and data from several others is submitted to State agencies on a voluntary basis.

As this abbreviated survey of the industry points out, monitoring around sulfuric acid plants is very much a function of the attitude of corporate management toward such activity, and it is approached in a variety of ways. Information obtained pointed out, as in other industries, that a "self-defense" motive is operating here, especially in the case of some larger producers. In the frequent cases where a relatively small sulfuric acid production process is part of another dominant process (e.g., for SO_2 recovery after metal smelting or refining), it is possible that monitoring of the sulfuric acid production is not a major consideration, either due to reduction of overall SO_2 emissions resulting from sulfuric acid production or the minor role played by its emissions compared to those of the main process or processes.

Table III-8

SURVEY SUMMARY OF SULFURIC ACID PLANT AIR QUALITY MONITORING*

Number of Networks	8
Number of Sources	8
Number of Stations with Continuous SO_2 Analyzers	30

*Note: This information is by no means a national total, but represents returns from a single producer.

Others

U.S. Army

The Air Pollution Engineering Division of the U.S. Army Environmental Hygiene Agency was identified as providing training, consultation, and equipment selection and testing services for a group of Army networks which are currently in a state of flux. Originally conceived as a system of 50 stations oriented towards acid, nitration, and power generation processes at about 20 active ammunition plants at U.S. arsenals, drastic recent reductions in arsenal activity and numbers of ammunition plants have changed this direction. Networks for a total of 9 arsenals exist or are being considered, as well as networks at one facility for destruction of munitions and chemical warfare agents and one research facility. One or two stations will be located at various other facilities for periods of a year or more, primarily for background data where current emissions are minor.

All stations in these networks will be the same, comprised of a Hi-Vol particulate sampler, continuous NO_2 and SO_2 analyzers and meteorological instruments. Stations will be operated by personnel from the monitored facility, but data will be collected for the entire system by a key data processing group at the Pine Bluff, Arkansas, Arsenal. Relevant statistics are summarized in Table II-2 and II-4.

Tennessee Valley Authority (TVA)

Figure III-2 and Table III-9 describe in full the air quality and meteorological monitoring efforts of TVA. These include networks around 12 electric generation plants, 5 trend stations, and three stations at the TVA Office of Agricultural and Chemical Development as well as meteorological instruments at 5 nuclear plant sites and one other location.

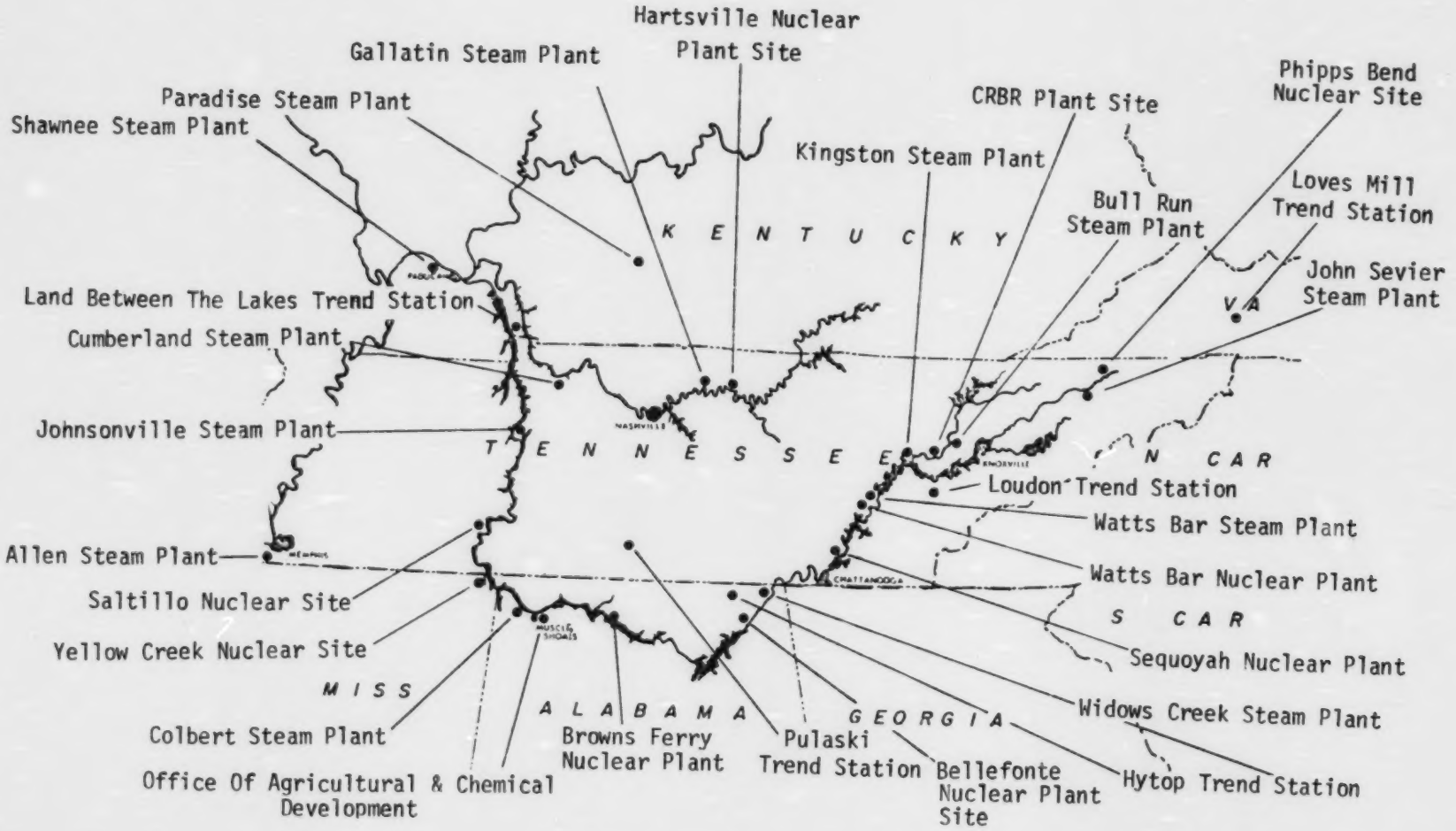

Hartsville Nuclear Plant Site
Gallatin Steam Plant
Paradise Steam Plant
Shawnee Steam Plant
CRBR Plant Site
Phipps Bend Nuclear Site
Kingston Steam Plant
Bull Run Steam Plant
Loves Mill Trend Station
John Sevier Steam Plant
K E N T U C K Y
V A
Land Between The Lakes Trend Station
Cumberland Steam Plant
Johnsonville Steam Plant
T E N N E S S E E
N C A R
Loudon Trend Station
Watts Bar Steam Plant
Watts Bar Nuclear Plant
Allen Steam Plant
Saltillo Nuclear Site
S C A R
Yellow Creek Nuclear Site
Sequoyah Nuclear Plant
M I S S
A L A B A M A
G E O R G I A
Widows Creek Steam Plant
Colbert Steam Plant
Browns Ferry Nuclear Plant
Pulaski Trend Station
Bellefonte Nuclear Plant Site
Hytop Trend Station
Office Of Agricultural & Chemical Development

Figure III-2

TVA AIR QUALITY MONITORING NETWORK

JANUARY 1976

TABLE III-9

INSTRUMENTATION AT TVA AIR QUALITY MONITORING STATIONS

JANUARY 1, 1976

Air Monitoring

	Type and Number of Units												
	SO_2 Monitors				Particulates			Huey					
Plant	Philips	Thomas	CI	IDC	High Volume	Dustfall Container	AISI Tape	PbO_2 Plate	Fluoride Lime Paper	McMillan Ozone Monitor	Ozone Rubber Strips	Zinc and Steel Plates	Wong Rain Gage
Allen	5	1	-	-	3	3	1	-	-	-	-	-	-
Bull Run	2	1	-	-	5	12	-	36	-	-	-	-	-
Colbert	9	-	-	-	3	3	2	-	-	-	-	1	-
Cumberland	5	-	7	-	7	10	1	61	-	1	-	-	9
Gallatin	5	-	-	-	4	5	1	-	-	-	-	-	-
John Sevier	3	-	-	-	2	3	-	-	-	-	-	-	-
Johnsonville	11	1	-	-	5	4	1	5	6	-	-	-	-
Kingston	9	1	-	-	3	3	1	-	-	1	-	1	-
Paradise	8	1	-	4	5	7	1	-	-	-	-	-	-
Shawnee	11	2	-	-	4	4	1	-	2	1	-	-	-
Watts Bar	3	-	-	-	1	2	-	-	-	-	-	-	-
Widows Creek	14	3	-	-	6	7	2	17	-	-	-	7	-
OACD	-	-	-	-	3	7	1	-	9	-	-	1	-
Trend Station													
Hytop	-	-	-	-	1	1	-	1	1	-	1	1	-
LBL	-	-	-	-	1	1	-	1	1	-	1	1	1
Loudon	-	-	-	-	1	1	-	1	1	-	1	1	-
Pulaski	-	-	-	-	1	1	-	1	1	-	1	1	-
Virginia	-	-	-	-	1	1	-	1	1	-	1	1	-
Total	85	10	7	4	56	75	12	124	22	3	5	15	10

Miscellaneous

Through information submitted by companies surveyed for their involvement in the surveyed industries and through the in-depth state surveys, monitoring activity by at least nine unsurveyed industry types was identified, as noted in Table II-1. Statistics on this activity are contained in Tables II-2 and II-4. This scattered sample seems to indicate that considerable activity exists in the chemical processing industry, particularly around petrochemical plants, as well as in metals processing (especially iron and steel works, aluminum and zinc smelters and refineries of many kinds) and the foods processing industries. Except in the case of those industries identified in the state surveys, identification of these industries was a mere by-product of the actual investigation, and it is possible that several industries with considerable monitoring were not identified.

IV. STATE SURVEY RESULTS

Introduction

This chapter presents results of the two in-depth state surveys conducted in Michigan and Pennsylvania. Full tallies of information obtained on monitoring activity are presented in Appendix A.

Michigan

The in-depth review of monitoring in the State of Michigan included information about the two largest private electric utilities and the largest municipally-operated electric utility, a chemical company, a copper smelter, a pulp and paper mill, and the State Department of Natural Resources. The industries above operate a total of 56 of the 95 industry-operated stations identified in the State.

The State of Michigan's assessment of air quality utilizes data from both agency and industry networks. Table IV-1, extracted from the State-prepared Air Quality Report, 1975, shows the total number of sites and analyzers per county in networks operated by both industry and governmental agencies. The distribution of stations (in 40 of the 80 counties) is depicted on the map (Figure IV-1). The State reported an expected reduction in number of SO_2 bubbler stations operated by the agencies in 1976, but no changes in other monitoring are expected.

The 1975 Air Quality Report indicates that industry operated 71 of the 100 continuous SO_2 stations, 4 of the 28 SO_2 bubblers, and 46 of the 181 TSP stations. Twenty-eight industries operate 30 networks (33 total planned in 1977), with 89 stations reported in service in 1975. The rest are operated by the State and 4 local agencies. A fifth local agency is being dropped. See Table IV-2, below, for a summary of survey statistics.

None of the industry data is forwarded to EPA for entry into the SAROAD system file. All industry stations report either hourly (24 hour-TSP) or summarized data to the State. Summaries prepared of hourly data are returned

Table IV-1

Michigan Air Sampling Network[1]
1975
Air Quality Monitoring Sites by County*

County	Suspended Particulate	Gas Package**	SO_2 Continuous	NO_2 Continuous	CO Continuous	Ozone Continuous
Alger		1	1			
Alpena	3					
Bay	3		6			
Berrien	2		1			
Calhoun	4		1			
Cass	1					
Charlevoix	2					
Chippewa	1					
Delta	12	2+	3			
Eaton	2		1			
Emmet	2	2				
Genesee	21	2	1			1
Gratiot	1		1			
Hillsdale	1					
Houghton	3					
Huron			2			
Ingham	13	1	12	1		
Iosco	1					
Jackson	1					
Kalamazoo	2	1				
Kent	11	2	1	1	1	1
Macomb	12	3	3		1	
Manistee	2	1	1			
Marquette	7	1	4			
Mason	3					
Mecosta	1					
Menominee	1					
Midland	4	1	10			
Monroe	12	2	10			
Muskegon	6	3	8			
Oakland	5	2	2	1	1	
Ontonagon	6	1	7			
Ottawa	1		6			
Saginaw	6		1	1	4	
St. Clair	9		7	3	1	
Schoolcraft		1				
Van Buren	1					
Washtenaw	4		1			
Wayne	19	3++	17	1	5	2
Wexford	1					
TOTAL	186	29	107	8	13	4

*Note: Includes state, local, and industrial monitoring sites, whether operated full or part year.

** Gas package bubbler samples for both SO2 and NO_2 unless noted below.

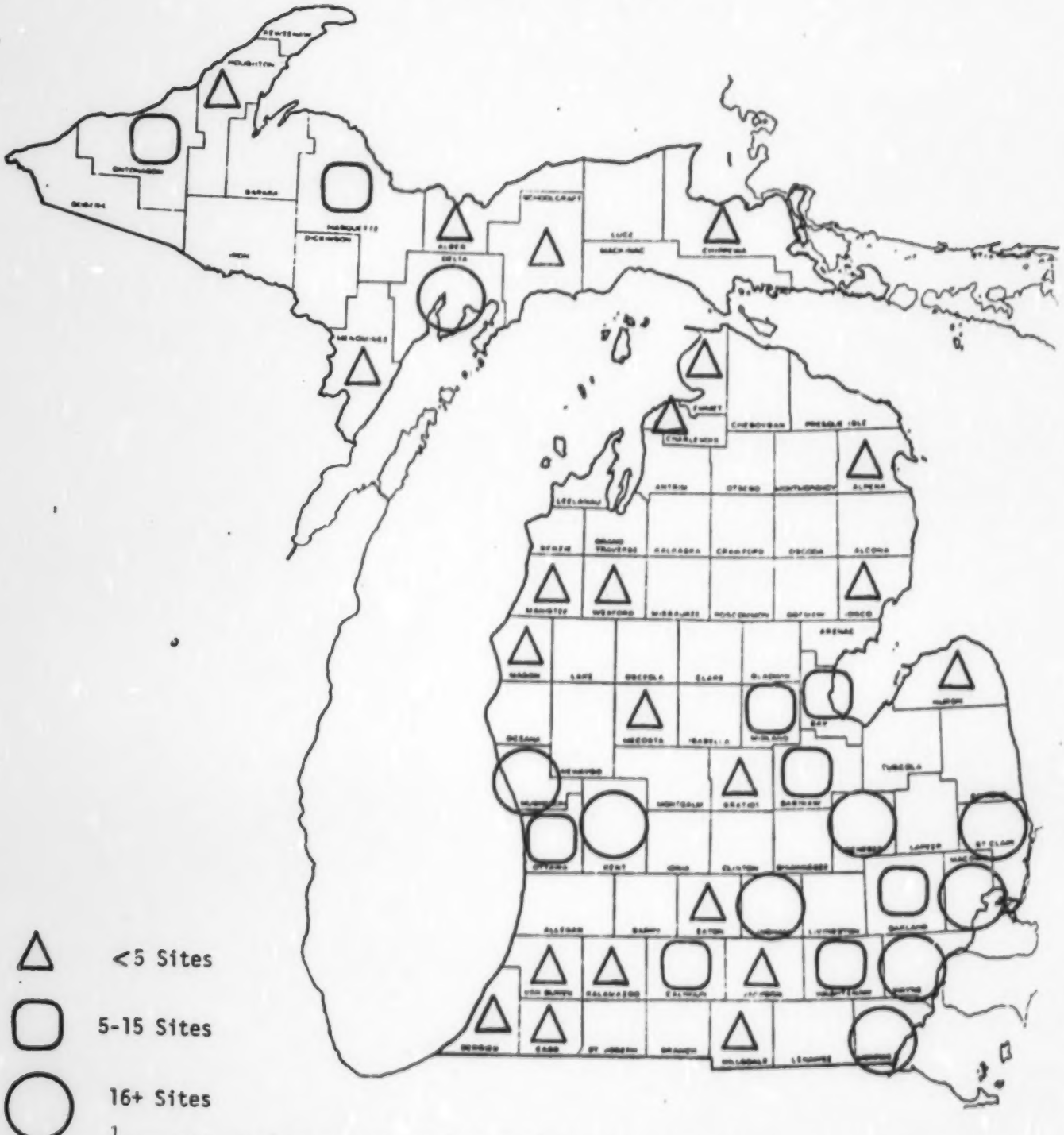
\+ No NO_2 at two sites.

++ No SO_2 at one site.

[1]From "Air Quality Report, 1975," Michigan Department of Natural Resources, Air Quality Division, p.10.

FIGURE IV-1

MICHIGAN AIR SAMPLING NETWORK[1]
1975
NUMBER OF SENSOR SITES PER COUNTY



[1]From "Air Quality Report, 1975," Michigan Department of Natural Resources, Air Quality Division, p.9.

Table IV-2

Survey Summary of State of Michigan Air Quality Monitoring

	Stations Industry operated In service		Stations Total Agency/Ind. op. In service	
	1975	1977	1974	1975
(Total Counties 80)				
Counties with A.Q. stations	22		32	40
Total Companies with Monitoring	25	29		
Number of networks	28	33		
Number of stations	89	97		
SO_2 Continuous	67	74	85	107
SO_2 Bubblers	4	2	29	29
TSP (Hi Vol)	40	52	186	186
NO_2 Continuous	2	2	8	8
CO Continuous	3	3	13	13
Met. (Wind speed/direction)	11	11	?	?
Met. (Tall towers/stability)	4	4	?	?

to the submitting industry. There was little indication that EPA was desirous of receiving the industry data, and the State did not appear eager to send it due to the added resources and expense required. Industries now supplying summaries have the data in computerized files so it was felt little additional expense would be required on the part of industry to provide all the readings (hourly or 24-hours) in SAROAD format for submission to EPA. No meteorological data is routinely submitted.

Quality of industry data, in a general sense, is felt to be good. The State has developed a quality assurance program and does perform spot checks on industry monitors periodically. No one is satisfied that quality assurance programs have done all that is needed. Most of the industry Hi-Vol. (TSP) filters are processed by the State laboratory.

Purposes of Networks: Industries in Michigan have generally initiated their own monitoring programs in order to assess the air quality impacts of their plants. The State agency has developed a good technical working relationship with industries and the burden of source-oriented monitoring has knowingly been passed on to the industry. The Michigan sulfur dioxide regulations may have a strong influence on this overall cooperation. These regulations permit variances regarding fuel sulfur contents, to be granted to 1980 providing industry can show ambient standards are not being violated around their sources. This permits industry to use the high sulfur fuels, allowing considerable savings in fuel costs for large fuel users. Such savings are large enough to make industries very willing to invest in ambient monitoring.

Many industries have therefore agreed to monitor as part of their contract negotiations for the variances. Two of the industries have negotiated for Supplemental Control System (SCS) operations. Monitoring is an SCS requirement. If the State foresees possible violation of ambient air quality standards near a new source, the industry is required to operate monitors and report the data as part of permit agreements.

Steam generation is the basic emission process being monitored overall. This includes electric utilities as well as production of process heat and

electric power for individual industries. This results in parameters monitored being primarily TSP and SO_2 along with meteorology. The exceptions are as follows: dust fall, sulfation, two NO_2 and three CO monitoring stations. No hydrocarbon monitoring by industry was reported. Sulfate analysis is made from some of the TSP filters. No nitrate analysis was reported.

Site Selection: In all cases the State reviewed and approved the monitoring sites selected, a variance-approval requirement. Models were seldom used by the State. Industry has used modeling to assist in site selection for many of the stations (this is required in the case of SCS networks). Very few have tested the models with data collected.

Pennsylvania

The review of monitoring in the State of Pennsylvania included information from the Air and Standards Committee of the Pennsylvania Electric Association, which is conducting an air monitoring survey, and with the State's Division of Environmental Resources. The industries of the Association operate 61 of the 208 stations in the State.

The Association has placed a contract for compiling a computerized (AQDHS-II) data base of industry and governmental agency operated air quality monitoring stations' data. The data from prior years (1958-1975) will be filed and it will be updated quarterly with current data. See Tables IV-3 and IV-4 from an initial report under this contract, for expected size of the data base and parameters. Figure IV-2 shows the distribution of all monitoring sites in Pennsylvania.

This report indicated that industry operates at least 58 of the 97 continuous SO_2 stations, and 43 of the 208 Hi-Vol samplers in Pennsylvania. The addition of only three new industry stations is expected by 1977. The State plans to add fifteen stations to their telemetered network. Table IV-5 gives a summary of survey statistics.

Table IV-3

HISTORICAL AEROMETRIC DATA (INSTRUMENT-YEARS) FROM 1968 THROUGH 1975

Pollutant Parameter	Magnetic Tape	Paper Copy	Strip Chart	Total Instrument Years
Huey Sulfation Plate	-	1109	-	1109
Hi-Vol Particulate				
a) Weight	206	643	-	849
b) Sulfate	152	448	-	600
c) Nitrate	152	245	-	397
Sulfur Dioxide	237	93	1	331
COH Particulate	140	52	-	192
Nitrogen Oxides	181	13	-	194
CH_4 & Non-Methane	66	-	-	66
Ozone	69	8	-	77
H_2S & Total Sulfur	56	-	-	56
Carbon Monoxide	60	20	-	80
Sub-Total For Pollutants	1319	2631	1	3951

Meteorological Parameter	Magnetic Tape	Paper Copy	Strip Chart	Total Instrument Years
Wind Speed	56	14	8	78
Wind Direction	56	14	8	78
Ambient Temperature	41	5	8	54
Dew Point/Wet Bulb/RH	35	11	8	54
Temperature Difference	40	3	-	43
Precipitation	3	11	8	22
Wind Oscillation	4	-	-	4
Solar Intensity	4	-	-	4
Nephelometer	6	-	-	6
Sub-Total For Meteorology	245	58	40	343
Total For All Parameters	1564	2689	41	4294

Table IV-4

CURRENT AEROMETRIC DATA (INSTRUMENT-YEARS PER YEAR) FROM 1976 ON

Pollutant Parameter	Magnetic Tape	Paper Copy	Strip Chart	Total Instrument Years
Huey Sulfation Plate	-	188	-	188
Hi-Vol Particulate				
a) Weight	-	208	-	208
b) Sulfate	-	146	-	146
c) Nitrate	-	111	-	111
Sulfur Dioxide	95	14	2	111
COH Particulate	69	14	-	83
Nitrogen Oxides	52	10	-	62
CH_4 & Non-Methane	39	-	-	39
Ozone	37	-	-	37
H_2S & Total Sulfur	34	-	-	34
Carbon Monoxide	31	-	-	31
Sub-Total For Pollutants	357	691	2	1055

Meteorological Parameter	Magnetic Tape	Paper Copy	Strip Chart	Total Instrument Years
Wind Speed	34	5	1	40
Wind Direction	34	5	1	40
Ambient Temperature	25	5	1	31
Dew Point/Wet Bulb/RH	28	4	-	32
Temperature Difference	4	5	1	10
Precipitation	3	-	-	3
Wind Oscillation	3	-	-	3
Solar Intensity	3	-	-	3
Nephelometer	23	5	1	29
Sub-Total For Meteorology	157	29	5	191
Total For All Parameters	514	620	7	1246

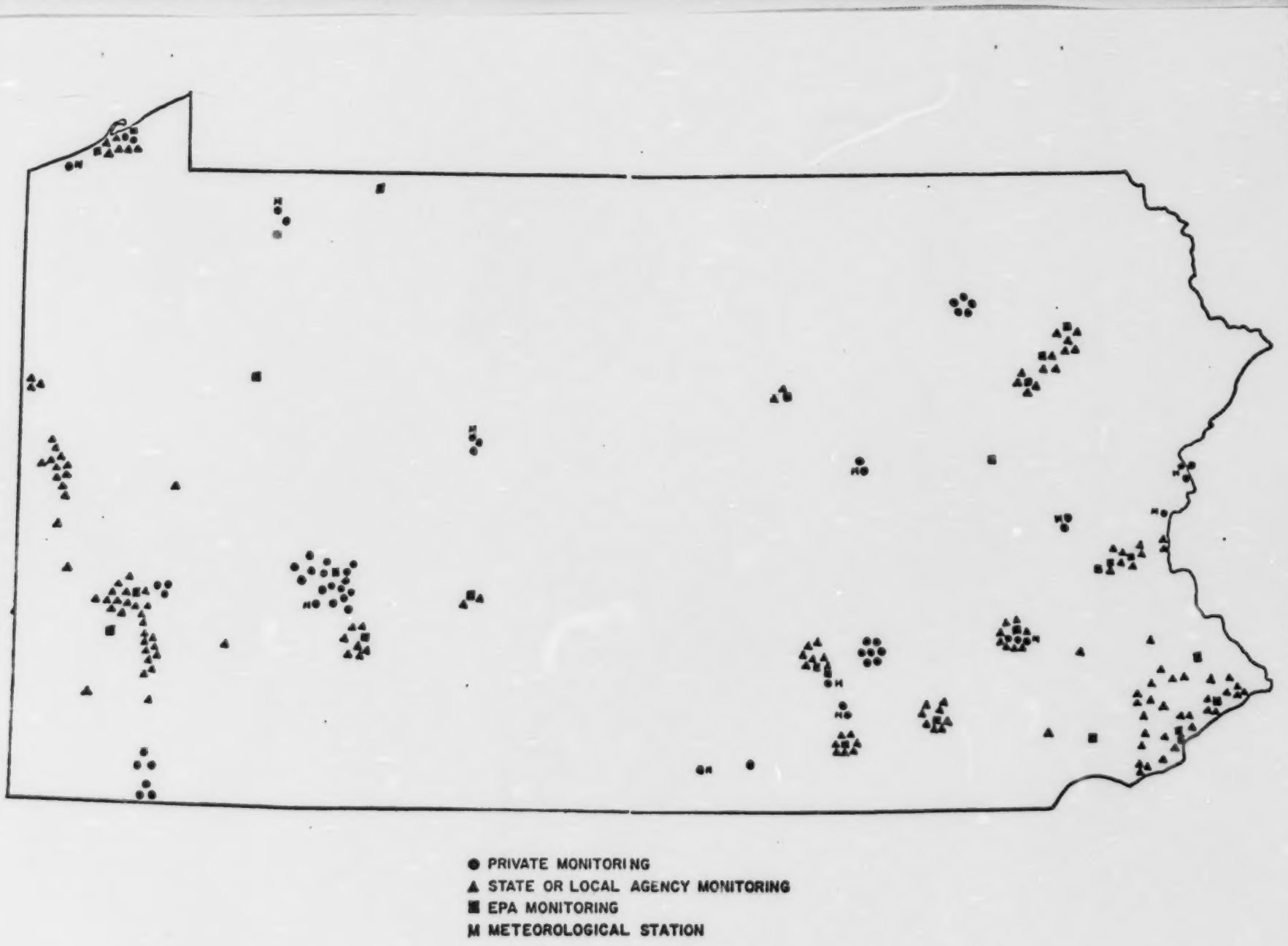


Figure IV-2. Ambient Air Quality Monitoring in Pennsylvania

Table IV-5

SURVEY SUMMARY OF STATE OF PENNSYLVANIA AIR QUALITY MONITORING

	Stations Industry Operated In Service 1975 - 1977		Stations Total Agency/ Industry Operated In Service 1974 - 1975
Total Companies with Monitoring			
Number of Networks	17		
Number of Stations	58	61	
SO_2 Continuous	58	61	97
SO_2 Bubblers	None		14
TSP Hi Vol	43	43	208
NO_2	28	28	62
COH Tape Samplers	29	?	83
H_2S	1	1	34
Met Wind Speed/Direction	8	8	40
Met (Tall Towers/Stability)	1	1	10

None of the industry data is forwarded to EPA for entry into the SAROAD system file. The industry data are not incorporated into air quality reports prepared by the State. Only a few industries are required and do report their data to the State. Originally, hourly and running averages were required. Now most submit summary data; i.e., the number of times the standards were violated and the readings as well as process operating data during the violations. Some report meteorological data also. Hourly data could be obtained. The basic factor influencing this is the State's or agencies' lack of a system for data collection and retrieval.

The quality of data prior to the last two years seems to be questionable. At present, the State does not have, and is not planning, a quality assurance (QA) program for the industries. Quality assurance program documentation for industrial monitors which will be submitting to the Pennsylvania Electric Association data base will be a product of the data base contract mentioned earlier.

Purposes of Networks: Industries in Pennsylvania have generally initiated their own monitoring programs in order to assess the air quality impacts of their plants. In a few instances, operation of a network and reports to the State are a requirement of the operating permit. The creation of an industry-operated data base of all ambient air quality data in Pennsylvania is a result of industry being unable to get the data from EPA or the State. Efforts are being made by industry to obtain permission to burn higher sulfur fuels based on improved emission inventories and ambient data which indicated initial strategy was more stringent than needed.

Some of the initial networks had real time capabilities in order to meet episode strategy requirements. No SCS systems appear to be contemplated. Forty-three TSP stations and fifty-eight SO_2 stations constituted the bulk of the monitoring by industry. A large number of tape samplers for coefficient of haze (28) and NO_2 monitors (29) are in operation. Some tape samplers may be discontinued. The majority of the industry networks also monitor meteorological data. Four have tall towers for stability and other meteorological parameters.

Sulfate analysis has been done routinely by the State for five years. Industry is also doing sulfate analysis. Sulfate averages are at levels of a recent EPA reported maximum. Nitrate and trace metals analysis is also done.

V. SYSTEM OPERATION AND COSTS

The cost analysis conducted as part of this survey resulted in collection and discussion of information on many aspects of ambient air quality monitoring. They will be summarized and discussed in the following sections on quality assurance, data handling, and costs.

Quality Assurance

The older and more experienced in air quality monitoring programs the industries are, the stronger is the concern for quality assurance (QA) programs. Most feel comfortable with data that had been collected the last couple of years. Those who have had to use or try to salvage older data are upset and critical of past data quality in general. There was no difference in confidence of data from industry or agency operated stations. There was a wide range of confidence expressed from one network's data to another and, in some cases, between specific stations of the same agency or company.

The extent to which formal quality assurance programs have been implemented depends to a large degree on the use of the data. Where the industry and/or agency management have serious potential consequence resulting from the data, there is a strong QA program. Where lesser importance is placed on the data, the QA program is also diminished.

Where industry is given feedback showing that the receiving State agencies need the data and when reports show the data were used, there is a good interest in monitoring and the QA programs are well advanced. One state has helped the quality assurance program by including in annual reports not only the agency or industry that operates each station, but, also, the name of the operator responsible in reports assessing the air quality. One industry reports that a competitive spirit exists between operators for quality and total valid data recovery. Recovery of 80 to 95% of the readings is considered reasonable for continuous gaseous analyzers. Meteorological instrument data recovery is higher.

Most QA programs are integrated into the overall operating procedures and do not stand alone. Very few industries presently have separate formal documented QA programs but several have them in development.

The routine span and zero calibration checks are common for most gaseous analyzers. Most networks have them done daily to once each fourth day with multi-point calibration checks at least once per month. Every quarter or six months the analyzers are returned to the shop or manufacturer for rebuild and recheck of calibration, traceable to the National Bureau of Standards (NBS). Meteorological instruments do not require the daily/monthly checks but in many systems get bi-annual repair and testing.

One major network abandoned, after several years of operation, their policy of adjusting data based on the daily calibration checks. They are convinced the analyzers are more stable (less drift) than the field calibrators. This has proven out in units returned to the shop as described above, and is confirmed by other network operators.

The EPA emphasis on quality assurance has been heard and is supported by most in the industry. Some are using the EPA Guidelines to assist in documenting their own programs. There are a few who divide QA programs into two areas, field operations and in-house operations (including lab tests, repairs and data validation). One source reported that a good data validation program can be equal in cost (labor and computer time) to other data handling, report preparation and interpretation costs.

It is generally felt the network operators should have a documented quality assurance program which meets state and EPA minimum requirements prior to anyone being allowed to use the data or the system being considered operational. The industry or agencies responsible for filing the data must have procedures which insure QA programs exist and assure they are followed. The operators should have some procedures established that include human validation of data. Some auditing and spot checking should be done. Round robin and/or collaborative testing of calibration equipment and references are being done and are encouraged by industry.

Data from industry-operated stations in surveyed states are for the most part good quality and can be used by governmental agencies as if they were from their own networks. The agency in these cases must have a well-supported program of quality assurance. The lack of the QA programs diminishes the value of resources spent on monitoring.

Data Handling

It is difficult to distinguish data handling from other aspects of air quality monitoring activity in order to establish procedures and costs. Generally, the extensiveness and costs are related to the uses of the data. Computerized files of industry-operated stations'data are prepared by many of the larger networks. The survey did not address the question directly of how many are computerized. It is possible, based on observation during this study, that more than a third of industry's ambient air quality data are accessible from computer files.

The two states of the in-depth studies, Michigan and Pennsylvania, will soon have all industry and agency data on computerized files. The Michigan agency does not receive the hour-by-hour data from industries that have data in computer files, but receives only summaries. Michigan could, if needed, get the hourly data in SAROAD format. Michigan keypunches and enters the hourly and other data from industries into the State computer and prepares summary reports when it is submitted on manually prepared reports. The State sends EPA SAROAD-formatted data for agency operated stations and can output as SAROAD formatted data this portion of industry data now.

Our survey indicates the cost of chart reading and keypunching to be 1/12 man per continuous analyzer per month or about $75 per month. One commercial services vendor's published prices show charges of about $35 per continuous parameter per month to read field-recorded magnetic tape data into an archive file, validate it and print a summary report and maintain the file. Costs of SAROAD-formatted data from commercial services vendors computer files are reported to be from $10 to $20 per month per continuous parameter. The software development cost for outputting SAROAD data from an industry file was quoted at $1100.

Extending these costs to, for example, computerization of all Michigan SO_2 data from industry, costs for data from 22 stations to be read manually and punched (at \$75/month = \$1650) and for accessing 45 stations' data from industry-computerized files (at \$20/month = \$900) would total about \$30,600 per year. This puts industry data in SAROAD format suitable for entry to the AEROS system from 67 analyzers at an average of about \$450 per year per analyzer. Based on the range of costs of other vendor services, this easily could be high by a factor of 2 yielding a range of \$225 to \$450.

The QA programs, the agency handling costs and other items such as original development of software all are in addition to this. Archiving costs can be estimated from costs quoted by a regular commercial data services vendor and from the vendor contract price for making a file of Pennsylvania's industrial and agency data. These address the creation of the file and the printout of a data summary only. These costs do not address the outputs formatted for management reports, modeling, or any other services normally required to interpret the data and also deals only with a minimal QA program. In the case of the Pennsylvania contract, much of the data will have previously been formatted for direct entry to the archive file (SAROAD format).

The Pennsylvania Electric Association contract to file historical data from 1968 through 1975 and update a current data file quarterly indicates what large scale computer file preparations and maintenance costs are. The actual number of readings cannot be deduced from available information but it appears there are about 514 continuous instruments' data to be input from magnetic tapes; 720 instruments' data input from reports; and 7 instruments' data input from strip charts to be filed each quarter for a total cost, including validation, of \$30,000 per year. See Pennsylvania section of Chapter IV for details. The historical file, data 1968-1975, preparation will cost \$60,000.

If each continuous instrument is assumed to produce 720 hourly readings monthly, as compared to 6 to 18 Hi-Vol or 6 bubbler readings per month, and one dust fall or sulfation reading per month, total data handling costs can be put in perspective. Data handling for 10 non-continuous instruments roughly equals the data handling for one continuous instrument. These assumptions allow estimated data handling for the equivalent of data from

600 continuous instruments for a total cost of $30,000 annually or $50 per year per continuous instrument for quarterly updates of the Pennsylvania file.

This would indicate a base cost for creating a national file of industry data of $275 to $500 per continuous analyzer per year. Non-continuous analyzers are about 1/10 of that or $30 to $50 per year. These figures do not include management support or overhead for quality assurance, intergovernmental communications and reports.

The general data handling programs of industry can be divided into two groups. The first group are those whose air quality station operators use the data to insure the analyzers are functioning properly and are creating a record of readings in case they are needed. The only reports prepared are the operator's analyses, which are reports of the readings observed as compared to the standards. Actual readings are reported, averaged, etc., only for the periods when the standards are approached or exceeded. This means the data handling and report preparation is minimal and usually assigned as part of the operations cost, resulting in no explicit data handling costs. The exception is where the State receives reports, when the $75/month mentioned above would apply.

The second group are those who assess impact and interpret results, from summaries, pollution and wind roses and other analyses. The data handling of this group is estimated by some to be equal to the actual cost of the field operations of the network, or approximately $3500 per year for one continuous SO_2 station data. This includes handling other supporting data such as wind speed and direction.

Costs

Information obtained on cost details fall in six different categories; five are addressed in the following section and one (data handling) in the prior section. Table V-1 presents a summary of the cost estimates arrived at.

The primary variable affecting the costs reported was the use intended for the data from the network. The range of initial costs for an average ambient air quality network station may vary by a factor of as much as 10. Reports of first costs ranged from under $8000 to over $70,000 each. The typical station (80% of cases) has a continuous SO_2 analyzer and a Hi-Vol sampler and an air-conditioned moveable shelter. One in five stations, or one in two networks, also monitors meteorology and many have more than wind speed and direction instruments in operation. One in fifteen stations or one in three networks has a tall meteorological tower to provide stability and other meteorological data. The ranges of costs and our estimate of the average costs of stations now in service are shown in Table V-1.

Costs of System Definition and Specifications: The variety of ambient air quality monitoring systems in use by industry around large sources virtually defies description. Descriptions of systems vary in complexity in proportion to the importance that management placed on the data being generated by the monitoring system.

The nearer the ambient air quality comes to exceeding the standards, the more sophisticated the station and the more all cost aspects increase. Very few SO_2 bubblers are operated since they cannot be used to assess impacts in terms of the secondary standard. No costs for bubbler stations and analysis were obtained. Sulfate (SO_4) analysis is now being done with HiVol filters by some industries, but costs were not available.

SCS-associated purposes are the intended use of data from about 25 networks with over 150 stations in service. Defining the purposes and specifying the system are often just part of the total effort in negotiations with agencies for approval of SCS use. SCS definition and specifications costs often exceed $250,000. Several companies have more than one source or plant with an SCS network. Considering many aspects, it is reasonable to estimate SCS description and specifications to cost an average of $150,000 per network.

TABLE V-I

SUMMARY OF COST ESTIMATES

	Item	Low	High	Estimated Average
1.	System Definition & Specifications	N/A	$250,000/Network	
	General Impact (1-3 sites) network	N/A	$100,000/Network	$ 25,000/Network
	SCS (6-15 sites) network	$100,000	$250,000/Network	$150,000/Network
2.	Siting & Site Preparation per Station	$100	$ 4,000/Station	$ 3,000/Station
3.	Capital Cost per Station	<$8,000>	$ 70,000/Station	
	SO_2 & HiVol			$ 23,000
	SO_2 & HiVol with Wind Speed, Direction			$ 29,000
	Tall Meteorological Tower with Instruments			$ 29,000
	Additional for NO_2			+$ 10,000
	Addition for Automated Data Handling	$3,000	$ 90,000	+$ 15,000
4.	Installation & Start-up per Station	$1,000	$ 3,000	$ 2,500
5.	Annual Operations	$2,600	$ 22,500	$ 20,000
6.	Annual Data Handling	0	$ 22,500	$ 3,500

Other stations' requirements often are described by operations personnel and the specifications supplied by vendors. Thus cost of this aspect is assessed as none or not applicable (N/A). Six-station networks' definition and specifications by consultants cost in a range of $100,000-$200,000. The average one-to-three station network cost is about $25,000.

Many industries have run AQDM (Air Quality Display Models) to assist in site selection. It is estimated that the running of the model and the report resulting from these runs costs from $2,000 to $5,000 when done by industry personnel, and $10,000 to $25,000 by outside consultants. The complexity of modeling is variable, and in some cases the costs are much higher than these. Model discussion brought critical comments on status of the emission inventories, emission factors and models. Those who had checked their data against the model predictions indicate very little agreement. Both over and under estimations were reported. Most felt, however, that it did a good job of helping to find the right site for an air quality monitoring station.

Sites and Siting: The costs associated in selecting, preparing and maintaining sites are extremely variable with many being located on company or donated (volunteered) property. Some sites were already level and fenced and some are left unfenced. Still others had to be leveled as well as fenced. The ranges of costs for both selection and preparation were estimated to be from $100 to an average of $4,000 per network station. We estimate, including the $100 to $500 1st year lease, the siting costs averages are about $3,000 per station.

Capital or 1st Costs: The typical costs for continuous SO_2 - HiVol stations were found to be under $8,200 with manual calibration systems and in air conditioned trailer type shelters. Even lower costs for non-air conditioned shelters (3 X 3 X 6 feet) were found, with three to six stations sharing the calibration system. The maximum cost was $33,000. The average cost of those in service is estimated to be $23,000. These are more sophisticated stations which include automated data collection and calibration systems and other parameters. The

costs of additional instrumentation for the more sophisticated stations are estimated as follows:

Wind Speed and Direction	$4,000
Tall Meteorological Tower and Instruments	$29,000
Continuous NO_2 Analyzer	$10,000
Automated Data Handling	$15,000
SCS Control Package (central computer-telemetry-stack monitors-software, etc.)	$250,000

Installation, Startup, and Annual Operations: Installation and startup of the basic TSP/SO_2 station was determined to cost from $1,000 to $3,000, including assembly, initial testing of instruments and other activities by industry or consultant personnel. Annual operations, maintenance and other costs for labor and materials range from $2,600 to $22,500 per station, depending on complexity of the station, operating procedures and personnel involved. In many cases of direct industry operation of networks, the costs of labor and management in these categories were hard to isolate due to other activities and responsibilities of involved personnel.

VI. NATIONAL COST ESTIMATES

This chapter presents preliminary estimates of the national cost of various elements of industry-operated monitoring systems as identified and described throughout this report. Average unit costs are taken from Table V-1. Unless otherwise noted, other statistics used are from Subtotal VI of the National Summary by Source Type (all stations identified except for Army networks), Appendix C.

Summary

Table VI-1 presents results of the calculations discussed below. No effort has been made to account for the fact that the one-time costs were incurred over a period of several years (mostly since 1970) or for depreciation, changes in prices over time (prices used are current), or other factors. It should be noted that these are preliminary, rough estimates in all. Even though several costs can be estimated with relative confidence, some--especially the annual operating costs--can only be relied upon as indicators of the likely magnitude of these costs. The annual costs, which most likely lie in the range of $15 to $25 million per year, are the most relevant factor here.

System Definition and Specifications

Based on the network size distributions in Table II-3 and an additional estimate of $50,000 per network in the five to seven station range, the following rough calculations were made. All pulp and paper mill networks were assumed to be less than five stations.

Stations

1-4	203 x $ 25,000 =	$ 5,075,000
5-7	45 x $ 50,000 =	$ 2,250,000
8+	32 x $150,000 =	$ 4,800,000
Total cost of System Definition and Specification:		$12,125,000

TABLE VI-1

PRELIMINARY NATIONAL COST ESTIMATES

(Millions of Dollars)

Item		
One-Time Costs: Total		49.7
Systems Definition and Specifications	12.1	
Siting + Site Preparation	3.1	
Capital Costs		
Basic Stations	24.3	
Meteorological Instruments	3.1	
NO_2 Instruments	0.6	
Automated Data Handling	3.9	
Installation and Startup	2.6	
Annual Operation and Data Handling Costs: Total		24.0

Siting and Site Preparation

For 1056 stations at a cost of $3,000 station, a total siting and preparation cost of $3,168,000 is estimated.

Capital Cost for Stations

For 1056 stations at a cost of $23,000 per station, a total cost of $24,288,000 is estimated for capital investment in stations, discounting all instrumentation beyond SO_2 and TSP instruments. Additional costs of $6,000 for 155 ordinary meteorological instruments and $35,000 for 62 tall towers accumulate to $3,100,000. Sixty NO_2 monitors add another $600,000. Firm data on automatic data handling was not obtained. However, based on the number of stations with real time access and observations in the course of the surveys, the data from at least a quarter of all stations are most likely handled by an automated system. For 260 stations, a total cost of $3,900,000 can be estimated for the capital investment in such systems.

Installation and Start-Up

One-time costs of $2,500 for 1056 stations gives an estimate of $2,640,000 for this item.

Annual Operations and Data Handling

These costs for 1056 stations, at $23,500 apiece, are estimated to lie in the area of $24,000,000 per year. These costs do not include costs for additional parameters, or other modification to the basic TSP/SO_2 station. Since this survey was not intended or able to make an extensive survey of such costs, these figures are not well-verified, but it is believed that they are of the correct magnitude. The estimated annual operating cost quoted here is heavily influenced by rates charged by consultants, and it was not possible to obtain sufficient data on costs and use of consultants across the entire survey population.

SAROAD Entry

Based on the estimate of $450 per parameter per year, it would be hypothetically possible to obtain all industry-collected ambient air quality data

(1702 parameter-years) for entry into SAROAD at an additional annual cost of $765,900 to industry. This includes only the technical process of production of SAROAD-formatted data by the industry and does not include costs of management or other activities within the industry, coordination between industries, states and EPA Regional and headquarters personnel or other costs at these other levels.

Appendix A

STATE SURVEY TALLIES

SURVEY OF LARGE POINT SOURCES MONITORING AMBIENT AIR QUALITY

EPA Region III
State of: Pennsylvania
Source Type: _____

Source Operator/Owner	# Sources/AQ network	# AQ stations	# in-service 7/75	# in-service 1/77	Data entered into NADB	Real time access	# SO_2 analyzers	Type SO_2 analyzers	# NO_2 analyzers	Type NO_2 analyzers	# TSP Samplers (H. Vol)	Other Analyzers	# /Met	#/Met Tell Tower	SO_4 Analysis	Self-operated
ELECTRIC UTILITIES																
Pennsylvania Electric Company																
Chestnut Ridge Area	3	17	17			Yes										
Homer City Plant							17	Cont	5	Cont	17	5 tape		1	Yes	Yes
Conemaugh Plant																
Seward Plant																
Shawville	1	3	3				3		3		3	3 tape		1		
Warren	1	3	3				3		3		3	3 tape	1			
Front Street Plant (Erie)	1	3	3			Yes	3	Cont	3	Cont	3	3 tape		1	Yes	Yes
(G.E.-Hammermil Paper)																
(Future site - Coho Plant)	(+2)															
Metropolitan Edison																
Portland Plant	1	3		3		Yes	(+3)	Cont	3	Cont	3	3 tape	1		Yes	No
Titus Plant	1	3	3				3		3		3	3 tape	1			
Crawford Plant	1	1	1				1		1		1		1			
(oil fired gas turbine)	1	1	1			Yes	1	Cont	1	Cont	1	1 tape	1		Yes	No
Pennsylvania Power & Light																
Montaur	1	2	2		No	No	2	Cont			2	2 tape	1			Yes
?	1	1	1		No	No	1	Cont			1	1 tape	1			Yes
Dusquene Light	1	3	3		No	Yes	3	Cont				3 tape				No

SURVEY OF LARGE POINT SOURCES MONITORING AMBIENT AIR QUALITY

EPA Region III

State of: Pennsylvania

Source Type: _____

Source Operator/Owner	# Sources/AQ network	# AQ stations	# in-service 7/75	# in-service 1/77	Data entered into NADB	Real time access	# SO_2 analyzers	Type SO_2 analyzers	# NO_2 analyzers	Type NO_2 analyzers	# TSP Samplers (H. Vol)	Other Analyzers	# /Met	#/Met Tall Tower	SO_4 Analysis	Self-operated
ELECTRIC UTILITIES (Continued)																
West Penn Power																
Hatfield	1	3	3		No		3	Cont				1 tape				No
Ft. Martin	1	3	3		No		3									No
SUBTOTAL UTILITY OPERATED	15	46	43	(+3)			43 (+3)		22		37	29 tape	7	3		
PULP & PAPER																
Charmin	1	5	5		No	Yes	5	Cont			5					No
Gladfelter	1	1	1				1	Cont			1	$1H_2S$				Yes
SUBTOTAL PULP & PAPER	2	6	6				6				6	$1H_2S$				
COPPER & LEAD SMELTERS																
N.J. Zinc	1	2	2				2	Cont					1			Yes
OTHER INDUSTRIES																
Hershey Foods	7	7	7				7	Cont	6	Cont						Yes
TOTAL INDUSTRY OPERATED	25	61	58	(+3)			58 (+3)		28		43	29 tape 1 H_2S	8	3		

SURVEY OF LARGE POINT SOURCES MONITORING AMBIENT AIR QUALITY

EPA Region V

State of: Michigan (23)

Source Type: _____

Source Operator/Owner	# Sources/AQ network	# AQ stations	# in-service 7/75	# in-service 1/77	Data entered into NADB	Real time access	# SO_2 analyzers	Type SO_2 analyzers	# NO_2 analyzers	Type NO_2 analyzers	# TSP Samplers (H. Vol)	Other Analyzers	# /Met	#/Met Tall Tower	SO_4 Analysis	Self-operated
ELECTRIC UTILITIES																
City of -----:																
1. Coldwater (Branch County)	1				No											
2. Grand Haven (Ottawa County)	1	1	1				1	Cont								Yes
3. Holland (Ottawa County)	1	2	2				2	Cont					1			
4. Lansing (Ingham County) (Ottawa-Eckert-Erickson Stations)	3	10	10			Yes	10	Cont			7			1 (T-TD-DP-R-B)		
5. Marquette (Marquette County)	1	1	1	+1			1	Cont			(+2)					
Consumers Power Co. (3 plants)																
1. Karn-Weadock (Bay County)	2	5	5			No	5	Cont			No		1		No	
2. Campbell (+1 unit 1980) (Ottawa Co.)	1	2	2	+1		No	2	Cont			No		No			
3. Cobb (Muskegan County)	1	5	5			No	5	Cont			No		1			
Detroit Edison Co.																
1. North Area (St.Clair & Adjoin. Co.) (Greenwood Energy Center)	1	6	6			Yes	6	Cont	2	Cont	3	6 tapes	3	1	(Some)	-6
2. Belle River " " ")	1			+1		No	(+1)	Cont								
3. South Area (Monroe & " ")	1	8	8	+2		Yes	8(+2)	Cont			(+10)	8(+2) tapes	4	1 (T-TD-DP-)	"	-8
4. Harbor Beach (Huron County)	1	2	2			No	2	Cont			2				"	Yes
Upper Peninsula Power Co.																
1. Presque Isle (Marquette County)	1	3	3		No		3	Cont					1			
SUB-TOTALS 13 E.U. Plant Networks	16	45	45	+5			45(+3)		2		12+12		11+	3		

SURVEY OF LARGE POINT SOURCES MONITORING AMBIENT AIR QUALITY

EPA Region V

State of: Michigan

Source Type: _____

Source Operator/Owner	# Sources/AQ network	# AQ stations	# in-service 7/75	# in-service 1/77	Data entered into NADB	Real time access	# SO_2 analyzers	Type SO_2 analyzers	# NO_2 analyzers	Type NO_2 analyzers	# TSP Samplers (H. Vol)	Other Analyzers	# /Met	#/Met Tall Tower	SO_4 Analysis	Self-operated
PULP & PAPER MILLS																
1. Horner Waldorf (Ontonagon County)	1	1		+1	No		(+1)	Cont								
2. Kimberly Clark (Alger County)	1	2	1	+1			1(+1)	Cont								
3. Manistique (Schoolcraft County)	1	1	1				1 (Bubbler 1975 to Cont 1977)									
4. Meade (Delta County)	1	6	6				6 (3 Cont + 3 Bubblers)				6					
5. Menoshe (Allegan County)	1	1		+1			(+1)	Cont								
6. S. D. Warner (Muskegon County)	1	2	2				2	Cont								
7. Union Camp (Monroe County)	1	1	1		No		1	Cont				1				
SUB-TOTALS 7 PULP & PAPER MILLS	7	14	11				7(+4)	Cont			6	1				
PETROLEUM REFINERIES																
1. Total Leonard (Gratiot County)	1	1	1		No		1	Cont			1					
COPPER & LEAD SMELTERS																
1. White Pines Copper Co. (Ontonagon County)	1	4	4		No		4	Cont			4					

SURVEY OF LARGE POINT SOURCES MONITORING AMBIENT AIR QUALITY

EPA Region V

State of: Michigan

Source Type: _____

Source Operator/Owner	# Sources/AQ network	# AQ stations	# in-service 7/75	# in-service 1/77	Data entered into NADB	Real time access	# SO_2 analyzers	Type SO_2 analyzers	# NO_2 analyzers	Type NO_2 analyzers	# TSP Samplers (H. Vol)	Other Analyzers	# /Met	#/Met Tell Tower	SO_4 Analysis	Self-operated
OTHER INDUSTRIES																
1-5. Automotive Plants																
- General Motors (Genesee County)	1	6	6		No						6					
- General Motors (Saginaw County)	1	4	4								4					
- General Motors (Saginaw County)	1	3	3									(3 Co)	1			
- Ford (MaComb County)	1	2	2				2	Cont								
- Ford (Oakland County)	1	1	1				1	Cont								
6. Cereal Mfg. (Calhoun County)	1	1	1				1	Cont								
7. Chemical (Huron County)	1	1	1				1	Cont								
8. Chemical (Midland County)	1	8	8			Yes	8	Cont			4			1		-8
9. Salt (Manistee County)	1	1	1				1	Cont								
10. Salt (Manistee County)	1	1	1				1	Cont								
11. Railroad (Marquette County)	1	3			No						3					
SUB-TOTALS 11 OTHER NETWORKS	11	31	28				15		2		17					
TOTALS 33 NETWORKS; 28 COMPANIES	36	95	89	97	None	32	67(+7) 4(-1)	Cont Bubblers	2	Cont	40(+12)	3 (CO) 14(+2) Tape Samplers	13	4	(Partial of 16)	-22

Key (-_) or (+_) = Planned 1977

Cont = Continuous Analyzers

CO = Carbon Monoxide Samplers

Appendix B

SURVEY MATERIALS
FOR VENDOR AND IN-DEPTH STATE SURVEYS

The following notes on system descriptions and costs were used as introductory information in interviews conducted in the vendor and in-depth state surveys, in order to assure consistency in the data obtained for these items.

Survey Reference Material

SURVEY OF INFORMATION ON AIR QUALITY NETWORKS
AROUND LARGE POINT SOURCES

Typical Networks' Description and Costs.

I. Description and Specifications
   A. Purpose of Networks
   B. Site Selection Procedure
   C. Number of sites and reason for selection
   D. Description of typical Air Quality Monitoring Stations

II. Installation and Operation
   A. Installation and startup
   B. Operations
   C. Quality Assurance Programs
   D. Data uses and procedures

III. Costs of Monitoring Networks
   A. Defining purpose of Network and preparation of specifications
   B. Site Selection
   C. Station First Cost
   D. Installation and Startup
   E. Annual Operations
   F. Quality Assurance Programs
   G. Data handling and Report preparation

TYPICAL AMBIENT AIR QUALITY MONITORING NETWORKS

I. Description and Specifications:

A. Purpose of Networks:

1. Networks with two or more stations monitoring general impact of a large point sources emissions on Ambient Air Quality on a regular basis.

a. Existing source for General Information on Impact of plant emissions.

b. Existing source for possible modification.

c. Required by permit.

d. Temporary variance requirement.

e. ESECA, Energy Supply and Environmental Coordination Act

f. Other. (specify)

2. Networks with five or more stations (SCS guidelines suggest ten stations) monitoring ambient air quality and for use in control of source processes to prevent ambient levels from exceeding standards.

a. To prepare for SCS permit application.

b. SCS operations expected or approved.

3. Other purposes. (describe)

B. Site Selection Procedure:

1. Dispersion Models were run to aid in site selection.

a. By government agency.

b. By source company (or contractor).

2. Site selection was based on analysis by scientifically qualified:

a. Personnel of company staff.

b. Personnel outside the company.

3. Other. (specify)

C. Number of sites and reason for selection:

1. 1st station - is located at the expected short term (3-24 hr.) maximum concentration site.

2. 2nd station - is located at an upwind site for background data.

3. 3rd station (2nd sometimes) - is located at the expected long term (annual) maximum concentration site.

4. Other stations - are located at special interest sites or at alternate maximums (2nd wind direction or elevation point, near sensitive receptors, neighboring source, etc.). Specify.

D. Description of typical Air Quality Monitoring Stations:

1. Station types

a. Continuously monitors SO_2 and TSP at least once per 6 days.

b. Same as (a) except continuously monitors also wind speed and direction at the ten meter level.

2. Station type optional additions or alternatives.

a. Continuously monitors NO_2.

b. Total Soluble Sulfate analysis is made from Hi Vol filter (SO_4).

c. Wind speed and direction monitors are on a tall tower at more than one level.

d. TSP measurements are made more or less frequently. (Specify)

e. Bubblers only are used for SO_2. (Specify frequency)

f. Bubblers only are used for NO_2. (Specify frequency)

g. Additional gaseous and/or particulate measurements are made. (Specify parameter, method, and frequency)

h. Additional meteorological measurements are made. (Specify)

3. Typical Configuration of Monitoring Stations:

a. Station Shelter - is self-contained unit (portable) with air conditioning and heating unit. AC power is supplied by local

utility drop. It is permanently mounted on a concrete pad inside a fenced enclosure. (without water, sanitary sewer, or telephone connections, Hi Vol roof mountings, rail and ladder)

b. SO_2 -

1) Analyzer is a flame photometric detector type with H_2S scrubber and re-ignite timer circuit. The zero air, manifold and automatic calibration equipment are permanently installed in the station.

2) Linearized output is recorded on potentiometric strip chart recorder with ½% accuracy, 4 inch scale.

c. TSP - Hi Vol sampler to collect TSP samples, is equipped with a start stop timer and a pressure chart recorder. (Precision Balance, filter conditioner, and sulfate analysis equipment are not included with station.)

d. Wind Speed and Direction -

1) The system is cup anemometer and vane with less than 1 mph threshold, 0-540° direction output mounted on ten meter crank up tower.

2) Speed and direction output is recorded on potentiometric strip chart recorder, with ½% accuracy, dual 4 inch scales.

4. Optional Additions to Configuration of Monitoring Stations.

a. NO_2 -

1) Analyzer is a chemiluminescence type with NO and NO_2 outputs. The automatic calibration and other support equipment is permanently installed as part of the station.

2) The NO and NO_2 are both recorded on a dual pen potentiometric strip chart recorder, ½% accuracy, 4 inch scale.

b. The station is also equipped with an on-site batch type data acquisition system that permits processing all outputs except Hi Vol and sulfates by computers.

c. The station is also equipped with Telemetry Systems connected to a central station where analyzer output and status data is

collected and processed. Specify if central station does control equipment in monitoring stations.

d. Manual calibration of Analyzers is done by the operator, automatic equipment is not included.

e. 1) Meteorological Tower, 200 feet, with wind speed, direction monitored at two levels, temperature and temperature difference sensors. (Temperature sensors are mounted in aspirated shields.)

2) Outputs are recorded in the shelter on potentiometric strip chart recorders, with ½% accuracy, dual 4 inch scales.

f. Others. Specify.

1) Telephone

2) Security Alarms

3) Water and sewer

4) Etc.

II. Installation and Operations:

A. Installation and Startup:

1. Site Preparation - Typical costs for site preparation include the actual lease or purchase of property selected and the cost of site preparation. (i.e., clearing, grading, landscaping, fencing, utility connect charges and obtaining permits)

2. Assembly and Startup - Assembly and startup costs of typical stations include the cost of assembly in a shop and movement to the site, and startup by senior technical staff or vendor personnel.

B. Operations:

1. Typical Annual Station Costs - (Pro-rated from network costs) Station operating costs include the cost of sites, parts, spares, supplies, utilities, operators' transportation, special tools, technical expert assistance, major overhauls, quality assurance programs, supervision, data handling, report preparation and the operator.

2. Typical Station Operator Duties - The operator's basic duties are to perform the routine servicing and preventative maintenance of all equipment. In addition to daily automatic calibration checks the operator manually performs a multipoint calibration test at least once per month. He also repairs all equipment that can be readily repaired in the field. He is required to perform some verification of data recorded on site and after it has been entered into the computerized file system. He conditions and weighs the filters. He compiles and maintains an operator log and quality assurance records.

C. Quality Assurance Programs - take many forms and involve actions from concept to final reports. The end product in air monitoring systems is measurement data and characteristics.

Q.A. results of major importance are the accuracy, precision, and completeness of the data collected. The relative importance of accuracy, precision and completeness depends on the particular purpose of the user. Typical Q.A. programs include:

1. Special tests by analyzers and systems vendors during manufacture. (i.e. certified test results, specify)
2. Regular audits of measurements and all data handling operations are performed.
3. Mandatory and spot verification of some procedures and operations are performed.
4. Special record keeping and analysis of records to establish Q.A. results are performed.
5. Temporary stations verifying measurements and site locations are operated at side of (or on alternate) sites periodically.

D. Data Uses and Procedures:

1. On-Site Services - Typically the data is first used by the operator to ensure equipment is functioning properly. The operator alerts management to unusually high readings; those that approach or exceed the short term (3-24 hr.) standards. A couple of times per year he is instructed to observe output during predicted or high potential periods and report observations.

2. Validation On-Site - The operator uses the data to verify (100%) all calibration periods and times of the chart records. He assists in the validation of computerized listings.

3. Read and Keypunching - The charts are then forwarded to the Central Office where they are read, converted to units of the standard and key punched.

4. Storage in Computer Files - The cards then are used to update a computerized historical file system and prepare a report listing all readings. Annually the stored data is processed to determine annual averages.

5. Audits, Validation and Report Preparation and Analysis - Technical staff analysis of the listings are used to assess the impact of the sources emission on the ambient and changes recognized, comparison to the standards are part of this analysis. Management reports which are also available to government agencies and the public are prepared. Validation of data, and audits are performed by the technical staff.

6. Formatted for NADB - SAROAD formatted data is prepared from the stored data quarterly and submitted to the state agency for transmittal to the EPA, National Air Data Bank (NADB). Meteorological parameters data is included in this submission.

7. Modeling - Periodically the data is input to models to verify proper site location and assist with analysis and report preparation.

8. Other - Other uses--please specify. (i.e., episode alarms, SCS, malfunctions alarm, servicing, etc.)

Survey Reference Material

(Do not release prior to interview)

III. Base Estimates of Monitoring Network Costs

A. Descriptions and Specification:

1. Defining purposes of network and preparation of specifications, supervision of purchase and installation

Type 1. Estimated Cost $ 25,000 per network

Type 2. Estimated Cost $ 100,000 per network

2. Site selection per network

a. Modeling Estimated Cost $ 2,500 per network

b. Technical Evaluations Estimated Cost $ 9,000 per network

B. Installation and Operation:

1. First Cost

a. Typical Stations

Type a Station (SO_2, TSP)	$ 26,750
Type b Station (" " & Met)	32,150

b. Options

- NO_2 + NO	13,275
- Automated data acquisition	
Batch type on-site	15,000
Plus telemetry	3,000
- Tall Met tower	
2 WS,2WD, T, T (includes tower erection)	29,200
- Manual calibration (less)$500/analyzer	

2. Installation and Startup

Type a Station	2,500
Type b Station	2,665
NO_2	115
Automated data acquisition	200
Tall Met tower	500

3. Annual Operating Costs Per Station

a. Operator	$10,000 per station
Operator per network is one to four stations $30,000 per year (salary, fringe & overhead)	
b. Transportation	1,500 per station
1/3 of network total - $ 4,500	
c. Other Costs	5,000 per station
Site lease, power, supplies, parts, etc.	

4. Quality Assurance Programs Per Station (Annually)

SO_2, TSP	1,000
SO_4	200
Met (Basic)	200
Met (Tall Tower)	1,000
NO_2	850

5. Data Handling and Services (annual)

Read Keypunch	
Continuous recording data	$ 360/Parameter
6 day sampled data	60/Parameter
Data Storage and Computer Listings	
Continuous recording	360/Parameter
6 day sampled data	60/Parameter
Analysis and Report Preparation	
Quarterly reports	600/Parameter
Real time (5 + Station Network)	30,000/Network
Modeling (3 + Station Network)	5,000/Network
SAROAD format (Tape or Cards)	
Hourly data	240/Parameter
24-hour data (60 days/yr)	60/Parameter

Appendix C

TABULATIONS AND SUMMARIES
TABULATION KEY

NATIONAL SUMMARY BY SOURCE TYPE

SURVEY OF LARGE POINT SOURCES MONITORING AMBIENT AIR QUALITY

Source Type	# Companies	# Networks	# Sources	# AQ stations	# in-service 7/75	# in-service 1/77	Data entered into SAROAD	Real time access +	# SO_2 analyzers	Type SO_2 analyzers	# NO_2 analyzers	Type NO_2 analyzers°	# TSP Samplers°	# /Met	#/Met Tell Tower	SO_4 Analysis +°	Self-operated +	Other Analyzers°
(a) Electric Utility	64	142	164	570	474	576	15:1	162:30	536 29	C B	41 9	C B	415	42	45	48:10S	147:43	47T,10X
(b) Copper/Lead Smelter	7*	13	15	104	98	114	---	98:11	103	C	---	-	67 (28L)	38	5	49:5S 61:7H	104:13	---
(c) Oil Refinery	4*	4	4	11	11	11	---	3:1	10	C	---	-	6	4	---	---	11:4	---
(d) Sulfuric Acid Plant	1	8	8	30	30	30	---	6:1	30	C	---	-	---	---	---	---	30:8	---
(e) Pulp and Paper Mill	<30	51	51	125	125	125	---	6:2	40 60	C B	5	C	125	38	2	---	---	7H_2S
Subtotal I	<106	218	242	840	738	856	15:1	275:45	719 89	C B	49 9	C B	613 (28L)	122	52	97:15S 61:7H	292:68	47T,10X, 7H_2S
(f) Miscellaneous	23*	32	31	96	92	96	3:1	8:1	51 7	C B	12	C	61 (5L)	19	2	10:6S 5:4H	38:15	1T,6CO,6HC, 6OX,1FL
Subtotal II	<127	250	273	936	830	952	18:2	283:46	770 96	C B	58 9	C B	674 (33L)	141	54	107:21S 66:11H	330:83	48T,6CO,6HC, 7OX,7H_2S,1FL
(g) Army (Various)	---	11	11	70	9	61	---	---	70	C	70	C	70	70	---	---	70:11	---
(h) TVA (Steam Plants)	---	12	12	109	109	134	109:12	---	106	C	---	-	55	4	8	45:10S	109:12	7T,10X
(i) Population-Oriented	1*	2	---	11	11	11	---	---	11	C	2	C	10	10	---	---	11:2	2HC,2CO, 4OX
Grand Total	<127	275	296	1126	959	1158	127:14	283:46	957 96	C B	130 9	C B	809 (33L)	225	62	152:31S 66:11H	520:108	55T,6CO,8HC, 12OX,7H_2S,1FL

* Companies in Multiple Categories

\+ Stations: Networks

° See Tabulation Key, following, for explanation of letter codes

NATIONAL SUMMARY BY SOURCE TYPE

SURVEY OF LARGE POINT SOURCES MONITORING AMBIENT AIR QUALITY

(Continued)

Source Type	# Companies	# Networks	# Sources	# AQ stations	# in-service 7/75	# in-service 1/77	Data entered into SAROAD	Real time access +	# SO_2 analyzers	Type SO_2 analyzers ○	# NO_2 analyzers	Type NO_2 analyzers ○	# TSP Samplers ○	¢ /Met	#/Met Tall Tower	SO_4 Analysis +○	Self-operated +	Other Analyzers ○
Subtotal III Source-Oriented (a through h)	126	273	296	1115	948	1147	127:14	283:14	946 96	C B	128 9	C B	799 (33L)	215	62	152:31S 66:11H	509:106	55T,4CO,6HC,7OX, 7H_2S,1FL
Subtotal IV Submitting to SAROAD	1 +TVA	14	18	127	122	153	127:14	--	120	C	---	-	58	7	9	48:11S	127:14	7T,10X
(III minus IV) Subtotal V Source-Oriented, Not Submitting to SAROAD	125	259	278	988	826	994	---	283:14	826 96	C B	128 9	C B	741 (33L)	208	53	104:20S 66:11H	382:92	48T,4CO,6HC, 60X,7H_2S,1FL
Subtotal VI Total Exclusive of Army	<127	264	285	1056	950	1097	127:14	283:14	887 96	C B	60 9	C B	739 (33L)	155	62	152:31S 66:11H	450:97	55T,6CO,8HC, 120X,7H_2S,1FL

* Companies in Multiple Categories

\+ Stations:Networks

○ See Tabulation Key, following, for explanation of letter codes.

TABULATION KEY

C - Continuous Type Sampler

B - Bubbler-Type Sampler

T - Tape Particulate Sampler

CO - Carbon Monoxide

HC - Hydrocarbons

OX - Oxidant

H_2S - Hydrogen Sulfide

H - Heavy Metal

FL - Flouride

S - Sulfates

L - Low-Volume Particulate Sampler:

When in parenthesis, such as (28L), indicates a number of low-volume samplers already included in the figure directly above.

TSP - Total Suspended Particulates

SO_2 - Sulfur Dioxide

NO_2 - Nitrogen Dioxide

SO_4 - Sulfate

Appendix D:

UNAPPENDED MATERIAL

Listed below are a number of source documents and working materials used in this survey, which may be interesting or useful to readers desiring more basic information. Single copies of these working materials were submitted separately to the Project Officer, Alan J. Hoffman, of the Monitoring and Reports Branch, Monitoring and Data Analysis Division.

- Edison Electric Institute Survey Materials
- TAPPI Ambient Monitoring Survey Report of Results
- Air Quality Report, 1974, State of Michigan
- Air Quality Report, 1975, State of Michigan
- 1975 Pennsylvania Air Quality Surveillance System Air Quality Report
- 1974 Air Quality Data for Arizona
- Tabulation and Original Tally Sheets
- State of Michigan Quality Assurance Documentation
- ASARCO Materials